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GOUGH (H. C.). **The Tortrix *Cnephasia longana* on Fruit Trees in Essex.**—*Plant Path.* **1** no. 1 p. 31, 3 refs. London, 1952.

In June 1949, apple trees at a place near Colchester, Essex, were damaged by Tortricid larvae from which adults determined as *Cnephasia longana* (Haw.) were reared. This species is of local distribution in England as far north as Yorkshire, but has not hitherto been recorded as injurious. In June 1951, a more serious attack occurred in the same place over several acres of young apples, few of which escaped damage. The larvae tunnelled into the tips of the shoots and also fed on the folded leaves, and the injury to the leading shoots was expected to have a serious effect on the growth of the trees. Less severe damage occurred in other orchards in the district. Pears and thistles were also attacked, though larvae were not found on the latter, and black currants in one plantation were severely damaged. Brief descriptions are given of the fully-fed larvae and the adults of both sexes of *C. longana*, and its numerous food-plants are reviewed from the literature.

Specifications and Methods of Analysis for certain Insecticides, Fungicides, and Herbicides.—*Tech. Bull. Minist. Agric.* no. 1 (2nd edn.), vi+69 pp., 1 fig. London, H.M.S.O., 1951. Price 2*s.* 6*d.*

This second edition of a bulletin already noticed differs from the first [*R.A.E.*, A **37** 400] by the inclusion of some additional fungicides and herbicides.

FISCHER (W.). **Die Untersuchung von Pflanzenschutzmitteln.** [The Analysis of Plant Protection Materials.]—HERRMANN (R.). *Handb. landw. Vers.-UntersMeth.* (*Methodenb.*) **7** 9¾×7 ins., viii+116 pp., many refs. Radebeul, &c., Neumann Verlag, 1951. Price *DM.* 13.50.

This book consists of a list of insecticides, fungicides and other materials used in plant protection. It is arranged alphabetically, and the information given includes notes on uses and composition, the standards to which the various substances should conform, and procedures for their detection and analysis in commercial preparations or residues. Certain physical properties of analytical importance are included in the list, and methods for their measurement are given. References to the literature are appended in many cases. The methods described are selected for their practical value or simplicity, and techniques requiring highly specialised apparatus, although sometimes more accurate, are omitted.

PEACOCK (A. D.), HALL (D. W.), SMITH (I. C.) & GOODFELLOW (A.). **The Biology and Control of the Ant Pest *Monomorium pharaonis* (L.).**—*Misc. Publ. Dep. Agric. Scot.* no. 17, pp. vi, 7–51, 5 figs., 10 refs. Edinburgh, H.M.S.O., 1950. Price 1*s.*

The authors give a short account of the bionomics of *Monomorium pharaonis* (L.), based mainly on observations on artificial laboratory colonies, summarise previous work on its control and give the results of quantitative laboratory experiments with poison baits. They also record observations on natural colonies, their dissemination and the degree of infestation of premises, discuss the procedures necessary for finding and destroying nests, and various methods of control, including traps and physical and chemical barriers, and give the results of experiments with poison baits in infested buildings of different types in Britain.

The poison baits used consisted of an attractant (cake, minced meat or liver), compounded to a moist paste with a solution of water, sugar, honey and about 0·5 per cent. thallium sulphate, or 0·8 per cent. sodium fluoride or both, and the relative amounts of carrier and poison solution were not standardised. In the laboratory, artificial colonies were fed mainly with liver, but additional food, such as brown sugar and other carbohydrates, was provided to maintain health. In tests of poison baits, liver and the bait were placed in the vessel containing the nest cell at equal distances from the open end of the latter, and the pre-adult and adult populations were counted at the beginning of the experiment and at intervals afterwards, usually daily ; the bait was renewed every 2–3 days. Change of diet from protein to carbohydrate or the reverse after a prolonged period of feeding on one staple food immediately attracted an increased number of ants. The earlier effects of poison baits on laboratory colonies included complete or partial immobilisation of the adults, resultant neglect by the workers of their feeding of the larvae and of other nest activities, cessation of egg-laying, and general disorganisation of social life. Sooner or later, the adults died from poisoning, the larvae from poisoning or neglect or both, and the eggs possibly from neglect. In general, the numbers of workers and larvae dropped sharply within the first 7–10 days, and the survivors were soon so few and their health so poor that the colony was unable to recover. It was generally necessary to continue baiting for at least 14 days, the time for the development of the youngest prepupae into feeding adults, although occasional colonies succumbed in less time. The rate of action did not depend on the size of the colony, possibly because of differences in vigour and constitution. Thallium sulphate acted more quickly on larvae but less quickly on workers than sodium fluoride, and when the mixture of the two was compared with each used alone, the mixture appeared to be the most effective and sodium fluoride was superior to thallium sulphate. Medium-sized colonies (700–1,000 individuals in all stages) that received baits poisoned with solutions containing 0·5 per cent. thallium sulphate, 1 per cent. sodium fluoride and a mixture of 0·5 per cent. thallium sulphate and 0·8 per cent. sodium fluoride reached the point of non-recovery in 33–50, 16 and 20 days and the point of extinction in 54–68, 25 and 29 days, respectively, but the critical points in other tests were sometimes reached much earlier or much later.

Observations on natural colonies in buildings showed that close proximity to food was not important, but that a temperature of about 80°F. and a relative humidity of about 80 per cent. were essential. Sexual forms appeared at any time of the year, depending largely on temperature and humidity. Mating was observed in laboratory nests, and it is assumed that nuptial journeys are not undertaken. Artificial dissemination results from the transfer of infested food and appliances, and natural dissemination from the movement of whole colonies to fresh nesting sites or the separation of nucleus colonies from an overcrowded nest. In both cases, females, males, workers, eggs and other pre-adult stages are involved, and no evidence of flight was obtained. Baits containing thallium sulphate, sodium fluoride or both were all effective in controlling natural infestations, but much longer periods were required than in the laboratory and it was impossible to determine which bait was the best. Mashed liver was the best carrier, but alternation of protein and carbohydrate proved desirable. In control work, regular weekly inspections are necessary to record progress and to replace dried or dislodged baits, change the kind of bait, establish new trails by baiting or redirect trails that have missed baits. The rapidity of control depends on the situation of the nest and conditions of food, temperature and humidity. Early and localised control was achieved within 2–9 weeks and considerable reduction in infestation in 13–24 weeks at some sites, but infestation persisted on a reduced scale in some cases for up to two years.

It is concluded that poison baits should prove effective if applied regularly for several months, and it is possible that treatment might be shortened by exposing and destroying nests and by the application of dusts or sprays. The possibility of preparing an improved bait from powdered dried liver and sodium fluosilicate is being considered.

JOYCE (R. J. V.). **The Ecology of Grasshoppers in east central Sudan.**—*Anti-Locust Bull.* no. 11, [4+] 97 pp., 5 pls., 24 figs., 19 refs. London, 1952.

An attempt in progress to develop the east central rainlands of the Anglo-Egyptian Sudan for the cultivation of millet (*Sorghum vulgare*) has been hampered by grasshoppers, which constitute the greatest single insect problem involved and have caused considerable crop losses. A general survey of the grasshopper fauna was accordingly made in the Gedaref district of the eastern Sudan during 1946–49, and an account of the work is given in this bulletin, which includes information on the topography, climate and vegetation of the area, an annotated list of the Acridids found, with notes, based on field observations and in some cases cage experiments, on their abundance, seasonal history, habitats and feeding habits, and discussions of the influence of soil and rainfall on the vegetation and of these and other factors on grasshoppers. The following is based on the author's summary.

The three major vegetation zones in the district are the short-grass area, the tall-grass plains (on which *Sorghum purpureo-sericeum* is dominant), and the woodlands. Agricultural development is largely confined to the tall-grass plains. The clay content of the soil, which determined the vertical distribution of water in it, was found to be an important factor governing the type of vegetation present. Acridids typical of light, well-drained soils in areas of high rainfall occur on soils of increasing clay content where the rainfall is lighter, and a typical fauna of relatively constant specific and numerical composition appears to be associated with soil of climactic clay content that receives water only as precipitation. Such a fauna occurs on the tall-grass plains, with seasonal and local variations due to changes in rainfall or clay content. Clay content and rainfall exert their greatest direct influence on Acridids in the egg stage, that of rainfall depending on the precipitation during the period of maximum oviposition, or, for species with a long egg stage, during incubation. The species present become sexually mature in regular seasonal succession; those that breed early are mostly geophilous, associated with low growing vegetation and near the wet limit of their range, and those that breed later, when more rain has fallen, are mostly phytophilous, associated with tall vegetation and near their dry limit. The effect of rainfall on the Acridids may thus be supplemented by its effect on the vegetation, since low dicotyledons such as *Ipomoea cordofana*, which make up the low stratum of vegetation, are favoured by poor rains unbroken by long drought, and the tall *S. purpureo-sericeum* by good, well distributed rains.

Of the 67 species of Acridids found, 32, mostly from the low-growing vegetation, damage the grain at the milky stage, but the only ones of importance are *Catantops axillaris* (Thnb.), *C. joycei* Dirsh [*R.A.E.*, A **38** 474], *Eyprepocnemis noxius* Dirsh [*loc. cit.*] and *Caloptenopsis insignis clara* (Wlk.), which breed in the stratum of low vegetation and congregate in the crop as the other plants dry out, though their numbers may also be supplemented by migration from drier areas, and *Aiolopus savignyi* (Krauss), which migrates from the drier short-grass area; *Locusta migratoria migratorioides* (R. & F.) in the solitary phase feeds on millet, but is not important as a pest. The only Acridids that damage seedling millet are *Pnorisa carinata* Uvarov, which causes serious losses only on newly ploughed grassland, and *A. savignyi*. Adults of the latter, which is by far the most important species, enter the

tall-grass plains in September-October and may devastate large areas. They appear to pass the dry season in cracks in the soil of cultivated land on the tall-grass plains, from which they emerge just before the rains, and sometimes give rise to a very early generation as a result of breeding on the threshing floors and in patches of an unidentified wild species of *Sorghum*. Most of the adults of this early generation migrate to the short-grass zone to breed, sometimes damaging seedling millet on the way. Adults of the next generation migrate back to the crop and have been reported congregating in swarms on patches of tall grass that occur typically in the short-grass zone.

Since grasshopper damage is heaviest in October, especially during the first half of the month when climatic conditions favour feeding and when crops in the milky stage are most vulnerable to attack, a considerable amount of protection can be achieved by adjusting sowing dates so that the crop is not at a susceptible stage at this time. This is best obtained by early sowing on land that has previously been cropped and by late sowing on land that has previously been uncultivated or under grass ley. This would normally also prevent damage to seedlings, since land previously cropped is not colonised by *P. carinata* and the early sowings should be well established before the first generation of *A. savignyi* has become adult. Late sowings similarly avoid damage by both species. Measures that favour the dominance of *S. purpureo-sericeum* and the suppression of the lower stratum of vegetation will reduce numbers in the species that breed in the tall-grass plains. This requires a rotation resulting in the maximum conservation of soil moisture, and preliminary data indicate that disking the soil clean one season before it is to be cropped is beneficial. Grasshoppers showed considerable preferences among different varieties of *Sorghum*.

OXLEY (T. A.). **Grain Storage in East and Central Africa. Report of a Survey (Oct. 1948 to Jan. 1949).**—*Colon. Res. Publ.* no. 5, iv+43 pp., 20 pls. London, H.M.S.O., 1950. Price 3*s*.

A survey of the problems associated with the storage of grain and the methods in use in Central and East Africa was made between October 1948 and January 1949 to provide data on which recommendations for storage methods suitable for use in tropical colonial territories might be based. The countries visited were Northern and Southern Rhodesia, Nyasaland, Tanganyika, Kenya, Uganda and the Anglo-Egyptian Sudan, and the stored grain examined included maize, sorghum, wheat and some bulrush millet [*Pennisetum typhoides*] and finger millet [*Eleusine coracana*]. Most of the stores visited were of the European type, and the methods used for storage and the control of insects are described, with notes on their effectiveness, so far as it could be gauged from the incomplete data available and the author's own observations. The necessity for storing grain in these territories is explained, the cost of equipment is discussed, and the losses suffered are illustrated from records obtained locally.

Insect infestation was everywhere very severe; where grain was uninfested, it was mostly wheat that had been grown at high altitudes under cool, but not always damp, conditions. The chief insects found were *Calandra oryzae* (L.), which was the most important species everywhere except in the Sudan and attacked all cereals except those with very small grains such as the millets, *Tribolium castaneum* (Hbst.), which occurred in association with *C. oryzae* and was widespread and abundant, *Latheticus oryzae* Waterh., *Laemophloeus minutus* (Ol.) and *Oryzaephilus surinamensis* (L.), which were very common, singly or in association, but were not found as primary pests, *Tenebroides mauritanicus* (L.), which was abundant in infested stored maize, but may have fed entirely on other insects or frass produced by them, *Trogoderma granarium* Everts, which was widespread but infrequent except

in the Sudan, where grain is stored in large unprotected heaps and the high temperatures and low humidities destroy all other species, *Sitotroga cerealella* (Ol.), which was the most destructive pest of stored maize in some areas, especially maize on the cob in cribs, *Ephestia cautella* (Wlk.), which has recently become a major pest of stored grain in northern Tanganyika, *Rhizopertha dominica* (F.), which was rather uncommon, but infested sorghum and wheat in the Sudan and occurred in a sample of white sorghum from Tanganyika, and *Plodia interpunctella* (Hb.), which was widespread but not numerous ; *E. kuehniella* Zell. was present but not abundant. Incidental observations showed that stored beans and other leguminous food crops were frequently severely infested by Bruchids.

Insecticides were widely used, the commonest being BHC (benzene hexachloride) and fumigants. It was usual to dust the outside of bags of grain during stacking with a BHC dust containing 0·5 per cent. γ isomer ; this gives some mortality of *Calandra*, but its effectiveness is uncertain and it was of no value against larvae of *E. cautella* in Tanganyika. In the Eastern Province of Tanganyika, a dust of 0·025 per cent. γ BHC in diatomite is commonly mixed with the grain at the rate of 8 oz. per 220 lb. ; at this concentration, the dust is lethal to *C. oryzae* when evenly applied, but does not kill *Tribolium castaneum* or other common grain pests. Pyrethrum powder is mixed with the grain to some extent in Kenya and Northern Tanganyika, but this method is expensive, and experiments by Beckley indicated that it affords protection for not more than eight months ; this period is probably sufficient for most purposes. A method of injecting insecticidal dusts into bagged grain in a stream of compressed air is in use in Kenya, but did not give satisfactory distribution of DDT or BHC dust in controlled experiments. Compressed air flock guns used for applying insecticidal dusts to bag stacks in Tanganyika did not appear to confer any advantage over treatment by hand. Carbon bisulphide is widely used as a fumigant, and the fire hazards associated with it are not fully realised. The use on a general scale of more modern fumigants toxic to man is considered impracticable, in view of the shortage of skilled supervision by Europeans.

Throughout the area visited, infestation by insects was a more important source of loss than dampness, and infestation was largely confined to the outer layers of the stored grain, owing to the lethal effects of the internal heating caused by the insects themselves. This is of considerable significance for control, and as much use as possible should be made of the self-sterilising effect produced in grain stored in bulk. Grain is most commonly stored in the area in bags in stacks, and the stacks should be as large as possible, so as to reduce the surface area in proportion to the bulk. It is suggested that the outer layer of a stack should be constructed of bags filled with some heat-insulating material. Storage in bulks retained by walls of filled bags was satisfactory as a temporary measure. Structures of the African type were effective under some conditions, but the thin walls provided had little heat-insulating effect. The unprotected conical heaps in use in the Sudan appeared well adapted to the hot, dry climate, but more information is desirable on the bionomics of *Trogoderma granarium*, the only pest of importance. Storage in tanks or bins, the best method known, was unusual except in the Rhodesias and Nyasaland, and its use should be extended.

The report ends with recommendations for action by the Colonial Office and for the guidance of those actually concerned with grain storage in the tropics.

PEAKE (F. G. G.). **On a Bruchid Seed-borer in** *Acacia arabica*.—*Bull. ent. Res.* **43** pt. 2 pp. 317–324, 9 figs., 3 refs. London, 1952.

The seeds of *Acacia arabica*, which occurs in natural forests and is also grown from seed on the banks of the Blue Nile in the Anglo-Egyptian Sudan, are

frequently infested by *Bruchus baudoni* (Caillol), which renders them infertile. Polyphagous Bruchids of 11 other species have occasionally been reported from the seed, but only *B. baudoni* was observed by the author. It also infests *Dolichos lablab* and was once recorded from *Abutilon* sp. The adult, egg and larva are briefly described. Investigations on its bionomics showed that the adults usually survive for less than four days. They pair as they emerge from the pods, to which the females return within 48 hours to oviposit. In the presence of seeds of *Acacia arabica* removed from the pods, eggs were laid on their surface or on the container, but when pods containing seeds were present, most were deposited in broken parts of the pod. The larvae hatched after 9–10 days and wandered over the pods before entering the seeds. In outdoor cages, the total life-cycle lasted 5–6 weeks.

The percentage infestation in seeds that had been stored in the pod in a sack for 18 months was found to be 61, but the Bruchid was not purely a storage insect, since exit holes were found in 8 per cent. of the freshly fallen pods in the forest and occasionally in pods still on the trees. The daily emergence from fresh, green pods that were kept in cages from 4th March 1951 until early December was recorded and correlated with temperature and humidity. Emergence was highest during May–August, with a peak in mid-June and smaller ones in early May and late July ; throughout the rest of the period, corresponding to the dry season, there was a regular, small emergence of beetles, and adults that emerge then presumably oviposit in old pods on the forest floor. The temperature remained fairly constant throughout the period, and humidity appeared to be the factor responsible for the fluctuations in emergence. In the forest, pods are present on the trees from late December to March or April, when they fall to the ground and lie without germinating for several years ; pods are always available for oviposition, therefore, and there appears to be no complete diapause.

Since control on the trees is not at present feasible, the application of a contact insecticide to the pods as they are received would be the most practicable measure, and a test of its effectiveness is being made. Investigations on the existence of parasites of the Bruchid in other countries are also in progress ; none was found in the Sudan.

Moutia (L. A.) & Courtois (C. M.). **Parasites of the Moth-borers of Sugar-cane in Mauritius.**—*Bull. ent. Res.* **43** pt. 2 pp. 325–359, 7 figs., 46 refs. London, 1952.

The three moth-borers of sugar-cane in Mauritius are *Proceras sacchariphagus* Bojer, *Sesamia calamistis* Hmps., which is the species previously recorded there as *S. vuteria* (Stoll), and *Argyroploce* (*Eucosma, Olethreutes*) *schistaceana* (Sn.). Studies of their parasites were made to confirm and extend earlier findings [*R.A.E.*, A **5** 440] and provide a basis for further attempts at biological control [*cf.* **29** 610 ; **31** 161 ; **32** 338 ; **35** 1, etc.]. Descriptions are given of the immature stages of most of the parasites investigated, together with notes on their identity, bionomics and alternative hosts, and information on their importance in checking the moth-borers. The eggs of all three moths were parasitised by a species of *Trichogramma* tentatively determined as *australicum* Gir. [*cf.* **22** 259 ; **33** 370]. The females oviposit in host eggs up to 3–4 days old and lay about 40 eggs each. Three adults of *Trichogramma* were commonly reared from each egg of *Proceras* parasitised in the field, and two in the case of *Argyroploce* ; as many as 17 eggs were laid in one of *Proceras* in the laboratory, but only three individuals completed their development. Total development in summer, autumn and winter, when the mean temperatures were about 24, 21 and 18°C. [75·2, 69·8 and 64·4°F.], respectively, lasted 9, 11 and 22 days. The percentage parasitism of *Proceras* by this species reached 55·1 during

April–September, but the annual mean over a period of three years was only 5·9. The population of the parasite is probably prevented from increasing by the erratic distribution of *Proceras* in the cane fields and interruptions in the supply of host eggs due to the occurrence of fairly well defined generations. Parasitism of *Argyroploce* during April–June was much lower, and *Sesamia* was rarely attacked. The eggs of *Sesamia* and *Argyroploce* were also parasitised by a species of *Trichogramma* closely related to *T. nana* (Zehnt.), which did not oviposit in eggs of *Proceras* in the laboratory, and those of *Sesamia* by a Scelionid tentatively determined as *Platytelenomus hylas* Nixon, which was recorded first as *Telenomus* sp. [**5** 440] and later as *T.* (*Prophanurus*) *alecto* (Crwf.) [**22** 259]. The females of *P. hylas* oviposit in host eggs up to four days old. As many as five larvae were found in one host egg in the laboratory, but only one completed its development ; in field-collected material, two adults were occasionally reared from the same egg. Fertilised females laid an average of 69 eggs each, complete development lasted 12–17, 21·5–28 and 33 days in summer, autumn and winter, respectively, and the sexes were about equal in numbers. In laboratory tests, eggs of *Proceras* were not attacked. Parasitism by it was highest during May–July, when *Sesamia* is scarce.

Larvae of *Proceras* were attacked by *Apanteles flavipes* (Cam.), females of which laid an average of 262 eggs each at the rate of 60–65 per host in the body cavity ; an average of 44 larvae per host was found in the field [*cf.* **30** 475]. Females were more than twice as numerous as males, and development lasted 16–23 days in summer and 24–34 in winter. The abundance of this Braconid is limited by a hyperparasite tentatively determined as *Calliceras fijiensis* Ferrière, the eggs of which are deposited in the cocoon of *A. flavipes*, but are not attached to the host pupa, and the larvae feed externally. The females lay an average of 36 eggs each, and four adults were usually obtained from each host. Females were over three times as numerous as males, and complete development lasted 15 days in summer and 33 in winter. No parasitism of *Apanteles* was observed during December–July, when other hosts are presumably attacked. Larvae of *Sesamia* were parasitised by an unidentified Ichneumonid of the genus *Enicospilus*, which required 47 days for development in summer, when parasitism by it reached a peak, and 70 in winter. The pre-oviposition period in summer lasted 8–10 days, and eggs were most frequently laid in host larvae in the fourth or fifth instar. Males were over twice as numerous as females. Larvae of *Sesamia* and *Proceras* were parasitised by a nematode of the genus *Mermis* during March–April, when 20 and 15·5 per cent., respectively, were attacked.

The pupae of all three moths were parasitised by a species of *Tetrastichus* near *atriclavus* Waterst. The females lay an average of 75 eggs each, in the body cavity of the host pupa, which is attacked in any stage. Females greatly outnumbered males among adults reared from field-collected material ; each host generally gave rise to 20–60 adult parasites, though as many as 541 were obtained from one pupa of *Sesamia*. Development lasted 16 days in summer and 27 in winter. Parasitism reached a maximum during January–March, and *Sesamia* was the preferred host. The pupae of *Proceras* and *Sesamia* were attacked by two Ichneumonids, *Xanthopimpla citrina* (Hlmgr.) and the introduced *X. stemmator* (Thnb.) [**35** 1 ; **36** 210, etc.]. Development of the latter lasted 17 days in summer, and males were more numerous than females. Females of *X. citrina* oviposited 10–12 days after emerging in summer. Eggs were laid in host pupae of all ages but development was completed only in those 1–6 days old. One egg was laid in each host in the field, and though superparasitism occurred in the laboratory, only one adult developed in each host. The ratio of males to females was 3 : 2. The duration of development averaged 14 days in summer and 25 in winter. Adults are abundant in the uplands in January–April and in the lowlands in July–October, corresponding with the outbreak

periods of *Sesamia* and *Proceras*, respectively; peak parasitism occurred in January–February and July–August. *Argyroploce* was readily parasitised in the laboratory.

Data on the percentage parasitism of each moth by each parasite were collected over a period of two years and are shown in a table. Parasitism of *Argyroploce* by *Trichogramma* sp., its only parasite of significance, reached a maximum of 64·7 during October–November and a minimum of 10 during June–July. The highest estimated annual percentages of parasitism for the other hosts by any parasite were 7·5 by *Apanteles flavipes* in *Proceras* and 6·5 by *Platytelenomus hylas* in *Sesamia*. It is concluded that none exerts any substantial control, and that attempts to introduce suitable parasites from other countries should be continued.

PERKINS (J. F.). **On some British Species of *Ichneumon* and *Alomyia* (Hym., Ichneumonidae).**—*Bull. ent. Res.* **43** pt. 2 pp. 361–363, 4 figs., 3 refs. London, 1952.

Characters are given differentiating the females of *Ichneumon septentrionalis* Hlmgr., *I. septentrionalis* subsp. *scelestus*, n., and *I. suspiciosus* Wesm., and the males of the last two; no males of the typical *I. septentrionalis* were seen. Wesmael's series of *I. suspiciosus* in the Brussels Museum was found to include not only specimens agreeing with his original description of that species but also some of *I. septentrionalis*. *I. s. scelestus* is the form determined as *I. suspiciosus* by Thomson and Roman, and is recorded from England, Sweden, Switzerland and Czechoslovakia. Specimens of the true *I. suspiciosus* have been seen from Britain, where it has been reared from *Hepialus lupulinus* (L.) [*R.A.E.*, A **39** 83], Belgium and Switzerland.

It is also stated that *Alomya debellator* var. *minor* Ulbricht is a synonym of *A. semiflavus* Steph., which is specifically distinct from *A. debellator* (F.). Characters differentiating both sexes of the two species are given. The British Museum collection contains specimens of both from Britain and Germany and of *A. debellator* from several other European countries.

EVANS (G. O.). **On a new predatory Mite of economic Importance.**—*Bull. ent. Res.* **43** pt. 2 pp. 397–401, 3 figs., 5 refs. London, 1952.

Descriptions are given of the adults of both sexes of the Laelaptid, *Phytoseiulus speyeri*, gen. et sp.n., from examples taken together with *Typhlodromus cucumeris* Oudm. in the Canary Islands, where both species were found preying on *Tetranychus* sp. on tomato. The characters of the genus and those distinguishing it from *Phytoseius* and other closely related genera are described. It is stated in a foot-note that the erection of the subgenus *Amblyseiopsis* for *Amblyseius americanus* Garman [*R.A.E.*, A **38** 270] was not warranted.

LE PELLEY (R. H.) & GODDARD (W. H.). **On the Control by Insecticides of *Heteronychus consimilis* Kolbe (Dynastidae), a serious Pest of Wheat in Kenya.**—*Bull. ent. Res.* **43** pt. 2 pp. 403–406. London, 1952.

Heteronychus consimilis Kolbe is a major pest of wheat in two areas of Kenya situated at altitudes of 6,000–9,000 ft. The damage is caused chiefly by the adults, which develop in the wheat fields or move into them from neighbouring grassland and feed on the young shoots just below the surface of the soil, sometimes killing the plants. The damage may extend over whole fields, and three successive sowings have in some cases been destroyed. If the plants survive, the females oviposit among the roots, on which the larvae feed until the wheat is nearly mature.

Preliminary experiments in 1950 indicated that soil dressings of BHC (benzene hexachloride) might give control of this Dynastid, and further experiments with BHC and aldrin [1,2,3,4,10,10-hexachloro-1,4,4a,5,8,8a-hexahydro-1,4,5,8-diendomethanonaphthalene] were made in 1951 ; all experimental plots received a dressing of double superphosphate. Counts of dead adults on the plots were made for up to 47 days after sowing and showed that the most effective treatments were aldrin at 7·2 oz. technical material per acre applied with the fertiliser at the time of sowing, Mergamma A seed dressing (stated to contain 20 per cent. γ BHC) applied to the seed to give 3·25 oz. Mergamma A per acre, and Agrocide 7 (stated to contain 2·6 per cent γ BHC) applied as a seed dressing at 3·25 lb. per acre, all of which resulted in considerable increases in yield and appeared promising for use on a large scale. The other treatments tested were Agrocide 3 (stated to contain 0·65 per cent. γ BHC) applied with the fertiliser (which had to be used at a reduced rate as the mixture caused clogging) at 8 lb. 5 oz. per acre or 24 days after sowing by means of a rotary blower at 1 cwt. per acre, and a bait of 10 oz. Agrocide wettable powder (stated to contain 6·5 per cent. γ BHC) and 50 lb. bran per acre applied 24 days after sowing. The first two of these, but not the bait, were significantly better than no treatment. Broadly similar results were obtained in a second test, in which the last two treatments were omitted and aldrin was applied at 3·6 oz. per acre. Aldrin at that rate proved slightly but not significantly inferior to Mergamma A.

Howe (R. W.), Hayward (L. A. W.) & Cotterell (G. S.). **Control Measures in 1948–50 against Insects attacking Groundnuts stored at Kano, northern Nigeria.**—*Bull. ent. Res.* **43** pt. 2 pp. 259–279, 2 graphs, 1 ref. London, 1952.

An account is given of experimental work at Kano, northern Nigeria, in 1948–50 on the prevention and control of insect infestation in stored groundnuts [*cf. R.A.E.*, A **40** 200]. Infestation was so severe and the outbreak of *Trogoderma granarium* Everts in 1949 so serious that precedence had to be given to control. The following is almost entirely the authors' summary of the work.

The main method used to protect the crop was the application of DDT suspension sprays to the exterior of pyramids of bagged groundnuts stored in the open and to the walls of warehouses before the bags were stacked. The sprays were applied with a slow-moving orchard power sprayer, and 50 per cent. wettable powder applied to give about 360 mg. DDT per sq. ft. was found satisfactory. A wettable powder containing BHC (benzene hexachloride) applied at about 12 mg. γ isomer per sq. ft. was cheaper and just as good. The treatments markedly reduced populations of *Tribolium castaneum* (Hbst.), but had little effect on *Trogoderma*. Sprays of oil solutions were little used and were not very satisfactory.

Fumigation with methyl bromide was tested against *Trogoderma* in the best buildings available, but the gas was not satisfactorily retained for the 24-hour exposure period used and even with a dosage as high as 30 lb. methyl bromide in a compartment with a capacity of 13,700 cu. ft. containing 150 tons groundnuts, the concentration-time product [*cf.* **32** 311] was only about 50 mg./hours. This appeared to be just sufficient to give a complete kill of *Trogoderma* larvae at the prevailing temperature (just over 30°C. [86°F.]). The severe climate caused the buildings to deteriorate rapidly, and since it is impracticable under local conditions to obtain really satisfactory results in buildings with ridged iron roofs, it is suggested that flat concrete roofs and more suitable doors be fitted to them. Fumigation of pyramids under ordinary rick-sheets failed, as the sheets were not gas-tight, but good results were obtained when the pyramids were covered with gas-tight rubber sheets sealed together with a cocoon plastic. The fumigant was introduced at the top, and complete-

kill of a large population of *Trogoderma* was apparently achieved in a 150-ton experimental pyramid treated with 30 lb. methyl bromide and in a 750-ton commercial pyramid treated with 179 lb. Much higher concentration-time products were obtained than in the permanent buildings, presumably because of the much smaller air space under sheeting and the small loss through leaks. Loss through the cinder base of the pyramids to the earth was evidently not important, and weighting the bottom of the sheets against the plinth of the pyramid by sacks of groundnuts or rolls of rick-sheets was efficient. Flapping of the rubber sheets and sharp changes in surface temperature caused good circulation of gas, and its distribution was quite even. The lowest concentration-time products were obtained half-way up the pyramids. The fumigation of pyramids under prefabricated tents made of light sheeting is considered practicable. Fumigation of nearly 100 tons sorghum (guinea corn) loosely stacked in one of the buildings with 33 gals. of a 3 : 1 mixture of ethylene dichloride and carbon tetrachloride controlled *Trogoderma* and *Tribolium*, but the mixture was useless against these insects in closely stacked bags of groundnuts.

A Todd Insecticidal Fog Applicator [**35** 259] was used to introduce fogs into warehouses loaded too full of groundnuts to permit entry of operators or equipment. Regular treatment with a standard insecticide consisting of 5 per cent. DDT, 0·35 per cent. BHC and a little pyrethrin concentrate in dieseline appeared to check *Trogoderma* slightly, but had no effect on *Tribolium*. Hexaethyl tetraphosphate and tetraethyl pyrophosphate in dieseline or in water sprays were ineffective. The application of fogs of the standard mixture under the rick-sheets of covered pyramids gave little control, but introduction into the centre through a built-in pipe gave encouraging results against *Trogoderma*. Allowing a fog to drift over pyramids appeared useless, but there was a marked deposit on a pyramid still wet from previous spraying. Smoke generators were useful for applying DDT or BHC in limited circumstances.

The use of admixed dusts appears impracticable and should in any event be restricted to the outer bags of stacks. Silica, pyrethrum and BHC at reasonable dosages and DDT at an exceptionally high one all reduced damage to groundnuts by half in the outside sacks of pyramids, but were useless in the presence of a heavy infestation of *Trogoderma* in a warehouse. Laboratory tests showed that a local diatomite might be useful as an inert dust. Pyrethrum spread externally on sacks was of little use, and DDT-impregnated sacks failed against *Trogoderma*.

Many local methods of handling groundnuts tend to spread *Trogoderma*, but it seems unlikely that they can easily be eliminated. It is suggested that routine preventative spraying should be supplemented by a rational programme of transport to the ports and by administrative changes making infestation by *Trogoderma* a financial disadvantage.

SMITH (K. G.). **The Spraying of Bags of Cocoa Beans with a Macrodosage of DDT against *Ephestia* and *Tribolium*.**—*Bull. ent. Res.* **43** pt. 2 pp. 313–315, 1 graph, 1 ref. London, 1952.

In an experiment in southern Nigeria on the protection of stored cacao from infestation by *Ephestia cautella* (Wlk.) [*cf. R.A.E.*, A **40** 201], bags of cacao beans that were free from insects were placed in a shed, and all their visible surfaces and the surrounding floor sprayed with wettable DDT to give a heavy deposit, estimated at the end of the test to be 956 mg. DDT per sq. ft. Groundnuts infested by *E. cautella* and *Tribolium castancum* (Hbst.) were then introduced some distance from the cacao, surrounded by a barrier of adhesive to prevent migration of larvae, and removed after 19 days, when most of the *Ephestia*

adults had emerged from them. Subsequent observations showed that the treatment had no appreciable effect in preventing infestation of the cacao by *Ephestia*, and though the larvae pupated on the surface of the sacks instead of migrating to the stitching and folds in the normal manner, almost all gave rise to adults. The *Tribolium* adults were apparently killed on the surface of the bags, and no living adults or larvae were found in the cacao.

Insect Infestation of Stored Food Products in Nigeria. Report of a Survey, 1948-50, and of Control Measures adopted.—*Colon. Res. Publ.* no. 12, 40 pp., 4 pls., 7 figs., 7 refs. London, H.M.S.O., 1952. Price 5*s*.

Cargoes of imported stored products arriving in Britain have in recent years been subject to regular inspection, during which insect infestations of varying degrees of severity have been found. Studies were therefore initiated by the Colonial Office to provide data for the development of routine measures for the protection of commodities in store in Commonwealth countries of origin and during shipment [*cf.* also *R.A.E.*, A **40** 260]. The West African Stored Products Pest Infestation Survey was organised in 1946 to study the conditions prevailing in Gambia, Sierra Leone, the Gold Coast and Nigeria, and investigations were made in 1948–49 at Kano, in northern Nigeria, where the principal commodity in store is groundnuts, and Lagos in southern Nigeria, where the chief products are cacao and kernels of the oil palm [*Elaeis guineënsis*]. This bulletin contains brief accounts of the climate of the four territories and the methods of marketing, transporting and storing employed for crops produced in them, notes on the importance and bionomics of the principal insect pests associated with stored products in Nigeria, the practices that favour insect infestation there, estimates of the extent of losses of cacao and groundnuts due to insect infestation during storage, accounts of experimental and large-scale trials of control measures, recommendations for improvements in storage practice, practical control measures and administrative measures in Nigeria, and suggestions for future research ; tables showing the more important insect pests found during the survey, with their usual foodstuffs, and the percentage of shipments of cacao and shelled groundnuts found infested by them between April 1949 and January 1951 are given in an appendix. Much of the information relating to the insects present, the conditions of storage and work on control in Nigeria has already been noticed from more detailed sources [*R.A.E.*, A **40** 200, 201, 265, and preceding abstract].

In tests of the value of suspension sprays of DDT applied to empty storage premises at Lagos, wall deposits of 50 mg. DDT per sq. ft. gave complete control of adults of *Tribolium castaneum* (Hbst.) that were exposed to them after 32 weeks, and deposits of 50 and over 100 mg. per sq. ft. on the walls of cacao stores effectively controlled heavy infestations of *Lasioderma serricorne* (F.). Experiments showed that the routine spraying of empty stores or of produce in bags with DDT is unlikely to cause contamination, but there is some risk of tainting when cacao is stored in bags impregnated with BHC (benzene hexachloride). In small-scale trials, fumigation of empty sacks and of sacks containing cacao with methyl bromide gave good results, but hydrocyanic acid gas was of no value, though large numbers of *Tribolium* in the free air spaces were killed. Pyrethrum powder mixed with cacao at rates of up to 1 lb. per 140-lb. sack gave little protection from *Lasioderma*. The large-scale fumigation of groundnuts at Kano with methyl bromide [**40** 265] at first gave excellent control, but after six months, shipments arriving in Britain showed gradually increasing infestation by *Trogoderma granarium* Everts, and this is attributed to the cessation of skilled supervision, the shipping of unfumigated groundnuts and the deterioration of the fumigation buildings.

LEFÈVRE (P. C.). *Acraea acerata* **Hew. parasite de la patate douce.**—*Bull. agric. Congo belge* **39** no. 1 pp. 49–76, 10 figs., 11 refs. Brussels, 1948.

Acraea acerata Hew. causes serious damage to sweet potato (*Ipomoea batatas*) in the Belgian Congo. Damage is habitually reported at the beginning of the dry season, in June, from Kivu, where this Nymphalid is the most important pest of the crop, and Ruanda-Urundi, and it also occurs on sweet potato at Ituri [*cf. R.A.E.*, A **28** 311]. As a result of infestation, young plants yield few or no tubers, and the crop is delayed and reduced on older ones.

Studies on the bionomics of *A. acerata* showed that the females deposit eggs in groups of about 130 on the leaves, usually on the lower surface, at intervals of 1–4 days, beginning 11–12 days after emergence. The egg, larval and pupal stages lasted 8, 21–25 and 7–10 days at laboratory temperature in June, and ranged from 10 to 5·65, 28·5 to 16·12 and 10·2 to 6·14 days, respectively, as the temperature was raised from 20 to 30°C. [68 to 86°F.]. The larval stage lasted 29–32 days in October. Larvae kept at 40 per cent. humidity and various temperatures above 30°C. did not pupate and pupae kept at 21°C. [69·8°F.] and 70–75 per cent. humidity did not transform to adults, though eggs and larvae developed normally under these conditions. The larvae feed on the upper leaf surface in groups under webbing for 14–15 days after hatching and then separate, consuming the leaves entirely except for the veins. At this stage, most of them are found on the ground during the day and presumably feed in the evening or at night. In laboratory tests, larvae completed their development on *Ipomoea kentrocarpa*, *I. tenuirostris* and *I. lilacina*, but not on three other native Convolvulaceae, including *I. cairica*, or plants of other families. There were about twice as many females as males during the dry season, but equal numbers during the rains. Tests on the effect on development of interrupted feeding and feeding on leaves of different moisture contents are described.

No parasites of the eggs or adults of *Acraea* were observed, but the larvae were parasitised by *Apanteles acraeae* Wlkn., *Zenillia vara* Curran, *Charops* sp. and *Meteorus* sp. In the laboratory, these had combined egg and larval stages lasting 17–28, 22–25, 21–27 and 18–21 days and pupal stages lasting 8–11, 12–16, 10–16 and 7–9 days, respectively, and the adults survived for 3–23, 4–27, 3–36 and 5–20 days when given diluted honey. *Charops* was itself parasitised by one unidentified species of *Mesochorus*, and *A. acraeae* by another. The pupae of *Acraea* were parasitised by two species of *Brachymeria*, and the ants, *Camponotus rufoglaucus cinctellius* var. *ustithorax* Forel and *Pheidole megacephala* (F.), were predacious on the larvae. The total percentage parasitism in the dry season was too low to afford much control.

The only control measure practised is hand-collection of the larvae, which has not prevented serious damage. Dusting with pyrethrum powder at the rate of 54–90 lb. per acre is recommended for special purposes. In laboratory tests, derris powder gave more rapid initial mortality of larvae, but proved inferior after 47 hours, when pyrethrum had given complete kill. Investigations on hybrids of *Ipomoea batatas* and *I. cairica* have been begun, with a view to obtaining resistant plants.

SCHMITZ (G.). **La pyrale du caféier robusta** *Dichocrocis crocodora* **Meyrick.**—*Bull. agric. Congo belge* **39** no. 3 pp. 571–580, 8 figs. Brussels, 1948.

Dichocrocis crocodora (Meyr.), which has for some time been of minor importance on coffee in the Belgian Congo [*cf. R.A.E.*, A **28** 95], caused almost complete destruction of the crop in some plantations in the region of the Uele in 1941–42, was general throughout the lower Uele in 1946 and present, though less important, in the same plantations in 1947, when some in the district of the upper Uele were also attacked.

The females deposit 2–3 masses of 30–100 eggs each in 2–3 days, usually on the lower surfaces of the leaves, and the larvae feed for 15–20 days in colonies in folded leaves or between two tied together with silk. They disperse soon after the second moult and form shelters by rolling the edges of the leaves. They leave these at night to feed on other parts of the surface, and move to another leaf when the first is skeletonised. About 13–14 days after the third moult they descend to the ground and pupate among dead leaves. High humidity is required for successful pupation. The adults are active at night and survive for 4–5 days. Pairing occurs immediately after emergence, and oviposition begins 24–36 hours later. The egg, larval and pupal stages last 10–12, 35–40 and 20–50 days, and the life-cycle is much longer during the dry season than during the wet one. There are four generations a year in the Uele region, appreciable numbers of moths appearing about 30th March, 5th–10th June, 25th August and 1st–15th November. Colonies of young larvae are numerous, the larvae are most injurious, and the descent to the soil occurs 20–40, 35–55 and 55–70 days after adult emergence, respectively.

Control measures should be applied according to the stage of development, as shown by observations at two or three fixed points in the plantation. If large numbers of adults are present in late March, beating the low vegetation with brushes of twigs or palm leaves over a period of 10–12 days kills many of them. When the larvae occur in colonies, a rapid and cheap method of control is to pick the infested leaves and drop them on the ground, where they shrivel so that the colonies die. This should be begun when there are 4–5 colonies per tree (20 days after the appearance of the adults) and continued for 20–25 days, each row being treated twice at an interval of 10–15 days. Insecticides should be applied 35–60 days after the appearance of the first moths, when the larvae are actively feeding. Sprays containing 0·5–1 per cent. lead or calcium arsenate or 0·05–0·1 per cent. DDT are recommended against populations of more than 50 larvae per tree. If infestation is so severe that the trees are defoliated, the soil should be cleaned of débris, and hedges cut close 55–75 days after the appearance of the moths, and all the material removed should be burnt.

The eggs of *D. crocodora* are parasitised by *Trichogramma luteum* (Gir.) which is very abundant in some years, and the larvae by *Apanteles congoensis* Saeger [*cf.* **34** 80], which attacks up to 70–80 per cent. of them, and another species of *Apanteles*. A method of introducing *A. congoensis* into plantations in which it does not occur is described.

Hepburn (G. A.) & Bishop (H. J.). **Experiments with Poison Baits for Melon Flies.**—*Fmg in S. Afr.* **25** no. 287 pp. 67–68. Pretoria, 1950.

Since the bait-spray of 1 oz. sodium fluosilicate and 2 lb. white sugar in 4 gals. water, recommended for the control of Trypetids on cucurbits in South Africa [*cf. R.A.E.*, A **23** 183], has not given uniform results, its efficacy was tested in eastern Cape Province, where *Dacus ciliatus* Lw. and *D. bivittatus cucumarius* Sack are the main flies concerned. It was applied weekly in favourable weather from 30th December to 3rd March to pumpkins sown at the beginning of December, and the recommended supplementary measure of removing infested fruits was also carried out weekly. No control was obtained, and there was considerable mechanical injury as a result of inadvertent damage during the weekly removal of infested fruits, which was made difficult by the dense growth of the vines.

Laboratory and field tests were then undertaken to find a more effective treatment. *D. ciliatus* was the chief test insect in the laboratory, where bait-sprays containing BHC (benzene hexachloride) and parathion were both superior in toxicity and speed of action to the recommended one, even when the concentrations of sodium fluosilicate and sugar in it were increased to 2 oz.

and 3 lb., respectively ; the mortalities given in 24 hours by bait-sprays containing 0·062 per cent. BHC and 0·31 per cent. sodium fluosilicate were 94 and 45·6 per cent., respectively. Parathion was very rapid in action at a concentration as low as 0·005 per cent., and females affected by parathion or BHC died without ovipositing ; 0·05 per cent. wettable DDT was toxic to *D. ciliatus*, *D. b. cucumarius*, *Ceratitis capitata* (Wied.) and *Ceratitis* (*Pterandrus*) *rosa* Karsch, but was slower in action than BHC or parathion. The toxicity of bait-sprays containing BHC or parathion was not impaired when sugar of lower grade or golden syrup was substituted for white sugar, and both species of *Dacus* fed readily on them ; molasses appeared to be unattractive, however, and there was some indication that it reduced the toxicity of DDT.

In a field test, a bait-spray of 0·01 per cent. parathion in 10 per cent. golden syrup or 7·5 per cent. grade no. 1 sugar was applied to squashes weekly between 18th October and 21st December, and increased the percentage of uninfested fruits from 49·2 to 81·3. Rain fell on four occasions during the period, necessitating retreatment. These results are not regarded as conclusive, but a bait-spray of 0·5–1 oz. 15 per cent. wettable parathion and 3 lb. sugar in 4 gals. water is tentatively recommended. It should be applied as coarse droplets at a rate of 1 oz. per 12 ft. row at weekly intervals from the first appearance of the flowers.

DARLING (H. S.). **Cotton Growing at Zeidab, northern Sudan, and the Control of *Laphygma exigua*.**—*Emp. Cott. Gr. Rev.* **26** no. 4 pp. 271–277, 1 ref. London, 1949.

The following is virtually the author's summary. A brief description is given of the cultivation of American Upland cotton on Zeidab pump irrigation scheme in the Northern Province of the Anglo-Egyptian Sudan. Heavy attack by *Laphygma exigua* (Hb.), with consequent loss of yield, was associated with a long planting period involving a succession of sowings, and with over-watering at lengthy intervals. These practices prevented the crop as a whole from growing away from the attack. Good control of *Laphygma* was given by shortening the planting period and by watering lightly at frequent intervals, enabling the crop to grow quickly through the susceptible phase before serious attack could develop.

PEARSON (E. O.). **Field Key to the principal Disorders of Cotton in Africa.**—*Emp. Cott. Gr. Rev.* **27** no. 1 pp. 10–15, 2 refs. London, 1950.

This field key is divided into sections dealing with seedlings, whole plants, stems and branches, leaves, flower buds, flowers and green and mature bolls, respectively, and permits the pests, diseases and other agents that damage cotton in Africa to be identified from the injury caused [*cf. R.A.E.*, A **38** 268].

FIFE (L. C.). **Studies of the Diapause in the Pink Bollworm in Puerto Rico.**—*Tech. Bull. U.S. Dep. Agric.* no. 977, 26 pp., 7 figs., 56 refs. Washington, D.C., 1949.

The following is based on the author's summary. The effect of changes in the environment on the diapause in larvae of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) on cotton [*cf. R.A.E.*, A **28** 532] was studied in 1935–38 in the laboratory and in the field in Porto Rico, where the factor of extreme cold as a predisposing factor does not occur and where cotton is grown during the rainy season in one part of the island and during the dry season in another. It was found that larvae in diapause were most abundant in the field during periods of drought, regardless of the age of the crop or the time of year, but that a few were always present whatever the amount of rainfall, indicating the existence of an inherited cycle that cannot rapidly be broken.

In laboratory tests, in which larvae were reared on food of a known moisture content, the moisture content of the seed and lint was inversely proportional to the age of the boll and to the percentage of larvae to enter diapause, the coefficients of correlation being −0·986 and −0·397, respectively, and the moisture content of diapausing larvae was 7·9 per cent. lower than that of the others. The results indicated that under tropical conditions, the lack of moisture tends to induce the development of diapause and that the presence of moisture is the most important factor terminating it. A low relative humidity with high temperature reduces the water content of the larvae by evaporation, decreasing the rate of metabolism and causing arrested development, and dry food, caused by lack of rainfall, high temperatures, low humidity, excessive wind movement, high evaporation or lack of available moisture for plants, also reduces their water content. In the field, heavy rainfall and high temperature should result in the pupation of most diapausing larvae within 2½–3 months.

It is suggested that either adjusting the planting date to the distribution of rainfall or the use of irrigation might reduce the numbers of larvae in diapause, and therefore the numbers surviving from season to season, and so give practical control.

Donohoe (H. C.) & others. **Biology of the Raisin Moth.**—*Tech. Bull. U.S. Dep. Agric.* no. 994, 23 pp., 1 pl., 5 figs., 38 refs. Washington, D.C., 1949.

An account is given of investigations on the bionomics of *Ephestia figulilella* Gregson, which is an important pest of raisins in California, together with information on the injury that it causes [*cf. R.A.E.*, A **23** 19 ; **26** 118, 324]. The larvae have been found in cottonseed cake, cacao beans, and cashew kernels, in addition to drying, dried and decaying nectarines, plums, dates and other fruits. When pairs of moths were given access to water and kept at room temperature, the females laid an average of 351 eggs each, of which 75 per cent. hatched ; the males survived for an average of 11 days, and the females for 16. At a temperature of about 83°F., the egg, larval, prepupal and pupal stages lasted about 3–6, 32, 1 and 10 days, and development from egg to adult averaged 43 days. The larvae are attacked by three parasites [*cf.* **23** 19 ; **31** 197], which, however, do not give effective control.

Kassanis (B.). **Some Factors affecting the Transmission of Leaf-roll Virus by Aphids.**—*Ann. appl. Biol.* **39** no. 2 pp. 157–167, 1 pl., 13 refs. London, 1952.

The following is based almost entirely on the author's summary of this account of investigations on factors that influence the transmission of the virus of potato leaf-roll by *Myzus persicae* (Sulz.). *Datura tatula* was the host plant generally used ; it is more suitable for experimental purposes than potato, since it is more easily infected, provides a better source of virus for feeding Aphids, and produces symptoms more quickly and over a longer period of the year. An earlier finding that the virus can be transmitted by starved Aphids that feed on infested plants for only five minutes [*R.A.E.*, A **32** 260] was not confirmed. The shortest feeding time in which the Aphids became infective was two hours ; such Aphids did not infect healthy plants for the first two days after transference to them and, when transferred to a series of healthy plants at intervals, infected only a few. The ability to cause infection was increased by increasing the duration of feeding on the source of infection. Aphids that had fed for many days on infected plants infected healthy plants in the first 15 minutes of test feeding [*cf.* **29** 179] and they continued to cause infections for long periods.

Aphids became infective more readily when feeding on recently infected *D. tatula* showing only slight symptoms than on older plants with pronounced

chlorosis ; similarly, young potato sprouts showing no symptoms were better sources of virus for Aphids than older plants showing severe leaf-roll. Aphids became infected less readily from infected plants that had received dressings of nitrogenous fertiliser than from untreated ones.

The differences in severity of symptoms shown by potato plants infected with leaf-roll in the field occur mainly because of differences in the virulence of accompanying strains of potato virus X, but isolates of leaf-roll virus were found that also varied in virulence.

Howe (R. W.). **The Biology of the Rice Weevil,** *Calandra oryzae* **(L.).**—*Ann. appl. Biol.* **39** no. 2 pp. 168–180, 1 graph, 9 refs. London, 1952.

The studies reported in this paper were carried out to fill gaps in the knowledge of the biology of *Calandra oryzae* (L.), especially at the storage temperatures usual in Britain. The large strain of the weevil [*cf. R.A.E.*, A **33** 361] was used throughout, and the grain was wheat. The first concerned the rate of development, especially the duration of the individual larval instars. Successive daily estimates were made of the proportions of the population in each stage or instar by the dissection of grains, and their durations were obtained by applying the probit method used in biological assay [**22** 440]. The percentage moulted or changed from one stage to the next was considered analogous to percentage kill and the age of the insect in days as analogous to the dose applied. This gives a median period for the completion of development of each stage up to the end of the stage concerned and a series of probit lines or curves representing the rate of change from one stage to the next. The method is shown to give results comparable with those obtained by other methods, and the durations obtained at various temperatures and humidities are given in a table. The median periods from oviposition to the appearance of adults in the grain were 110·1 and 40·3 days at 70 per cent. relative humidity and 18 and 25°C. [64·4 and 77°F.], respectively, and 73·7 and 47·8 days at 21°C. [69·8°F.] and 50 and 80 per cent. relative humidity, respectively.

Other experiments showed that about 90 per cent. of the eggs laid by females of *C. oryzae* were fertile. Normally only one adult developed in a grain, all other individuals being destroyed by their fellows. The sexes were equally numerous.

E. L. Reuter in 1937 reported pairing between males of *C. granaria* (L.) and females of *C. oryzae*, but not the reverse cross. Viable eggs were subsequently laid, but it was not known that the females were unfertilised before the observed pairing. In a test by the author, no eggs were laid when males of *C. granaria* and unfertilised females of *C. oryzae* were isolated in pairs with wheat grains and no pairing was observed when the grains were changed.

The daily oviposition rate of *C. oryzae* at 25, 21 and 17°C. [62·6°F.] increased with relative humidity. There was a critical point at about 60 per cent. relative humidity below which egg laying declined rapidly and mortality was high. At 100 per cent. relative humidity, the numbers of eggs laid per female per day averaged 1·3, 2·5 and 3·4 at 17, 21 and 25°C., respectively. Under experimental conditions, most eggs per grain were obtained by isolating females with one grain each, but more eggs were laid by females given more than one grain. Daily egg output was reduced by grouping females or including males. In culture, depths of grain up to 7 cm. did not discourage egg-laying.

Hopf (H. S.). **Studies in the Mode of Action of Insecticides. I. Injection Experiments on the Role of Cholinesterase Inhibition.**—*Ann. appl. Biol.* **39** no. 2 pp. 193–202, 14 refs. London, 1952.

The effect of injecting cholinesters and compounds known to affect the activity of mammalian cholinesterases into insects was investigated as a

contribution towards an understanding of the mode of action of insecticides such as the phosphoric esters, which are known to inhibit cholinesterase in vertebrates and may also do so in insects [*R.A.E.*, A **39** 427, etc.].

When injected in solution into the body cavity of young adults of *Locusta migratoria migratorioides* (R. & F.) of an average weight of 1 gm., TEPP (tetraethyl pyrophosphate) and parathion were toxic, the median lethal doses being about 1·25 and 2 mmg. per locust, respectively, but acetylcholine chloride, acetyl-β-methylcholine, carbamyl choline, benzoyl choline chloride and choline chloride had no effect. Adrenalin and *d*-tubocurarine chloride, both of which affect the mammalian nervous system, also had no effect. Of two compounds that inhibit mammalian cholinesterase activity, prostigmine bromide gave 10 per cent. mortality when injected at the rate of 1,200 mmg. per locust, and eserine 50 per cent. mortality at 20–25 mmg. ; if the latter had been as toxic to locusts as it is to man, the median lethal dose would have been very much lower. Atropine, which is an antidote for poisoning by anti-cholinesterase activity in mammals, gave 35 per cent. mortality at 800 mmg. per locust. The toxic effects of TEPP and eserine were not antagonised by atropine or enhanced by *d*-tubocurarine chloride when these materials were injected immediately before or after injection of the insecticides or, in the case of TEPP, topical application to the head ; acetylcholine chloride injected immediately after TEPP had no effect on subsequent mortality.

In a discussion of these results, it is suggested that insects differ from mammals in that neither adrenalin nor cholinesters are concerned in the physiology of their nervous system and that phosphorus insecticides inhibit a general esterase not specifically connected with cholinesters [*cf.* **39** 427].

DAVID (W. A. L.). **Insecticidal-action Studies with Bisdimethylamino Fluorophosphine Oxide containing ^{32}Phosphorus.**—*Ann. appl. Biol.* **39** no. 2 pp. 203–210, 4 refs. London, 1952.

The following is almost entirely the author's summary. The absorption by plants of the systemic insecticide bis(dimethylamino) fluorophosphine oxide containing P^{32} was studied, and, where possible, comparisons were made with schradan (bisdimethylaminophosphonous anhydride) [*cf. R.A.E.*, A **39** 199, 428, etc.]. The radio-oxide was absorbed by the roots of broad-bean plants from culture solutions. The level of radioactivity in the plant increased as the solution was absorbed and was higher in the roots than in the rest of the plant. The radioactivity of the remaining culture solution decreased as more of it was taken up by the plants, showing that the roots selectively absorb the oxide from solution. In this respect, it differs from schradan, which is selectively rejected at similar rates of transpiration [**39** 428]. At the end of a day with their roots in the culture solution, the plants became free from Aphids. The radio-oxide was absorbed more rapidly by plants growing in sand than in soil, and Aphids were killed at lower dosages and in shorter periods on the former plants than on the latter.

An appreciable part of the oxide absorbed by the roots is given off as vapour by the leaves [*cf.* **39** 200]. This vapour was collected and shown to be radio-active and toxic to *Aphis fabae* Scop. on the cut tops of broad-bean plants. Examples of *A. fabae* feeding on treated plants were shown to contain radio-active material.

The radio-oxide was less soluble in lipoids than schradan and did not penetrate as readily into the leaves of broad beans. Since it is also lost by vaporisation from the plants, only small amounts were translocated following leaf applications to broad bean, cabbage and hops.

HEALY (M. J. R.). **A Table of Abbott's Correction for natural Mortality.**—*Ann. appl. Biol.* **39** no. 2 pp. 211–212. London, 1952.

It is common practice in tests of insecticides to observe a batch of untreated material so as to allow for a non-zero response when no treatment is applied. When such a response occurs, the observed responses to the different doses can be adjusted by a formula usually known as Abbott's correction [*R.A.E.*, A **13** 331]. The table given shows the correction to be subtracted from the observed response to obtain the adjusted one.

HERINGA (J. W.) & SWARBRICK (T.). **Petroleum Oil Fractions as Plant Spray Materials. The Effect of refining an Oil upon its Degree of Phytotoxicity.**—*Ann. appl. Biol.* **39** no. 2 pp. 213–220, 2 refs. London, 1952.

The following is the authors' summary. Data are presented showing the effect of degree of refining upon the specific gravity, viscosity, unsulphonatable mineral residue (U.R.), refractive index, average molecular weight, group analysis, sulphur content and phytotoxicity of two spindle oil distillates in the boiling range 300–390°C. Cucumber plants proved very suitable for demonstrating differences in phytotoxic properties of the oils. Spindle oils refined to a U.R. of 82 or higher, and a specific gravity of 0·885 or lower, showed no phytotoxicity in the tests on these plants. A fair agreement was found between the results of these tests and the specifications laid down by H. Martin [*R.A.E.*, A **23** 497] for spray oils.

DAVIES (R. G.) & EATON (J. K.). **The Effect of Hydrogen-ion Concentration on the ovicidal Activity of some Nitrophenol Emulsions.**—*36th Rep. E. Malling Res. Sta. 1948* pp. 111–117, 1 graph, 24 refs. East Malling, 1949.

The experiments described were carried out to test the reported effect of alkalinity in reducing the toxicity to insect eggs of nitrophenols in oil emulsion [*cf. R.A.E.*, A **27** 649 ; **33** 15]. Apple shoots bearing winter eggs of *Aphis pomi* Deg. were dipped in emulsions of 3 per cent. oil in which 2,4-dinitro-6-methylphenol (DNC), 2,4-dinitro-6-cyclohexylphenol [dinex] and 2,4-dinitro-6-methylphenyl acetate (DNC acetate) had been dissolved at concentrations known to give 0–100 per cent. mortality. Each compound was tested in emulsions of which the pH values were adjusted to range from about 4 to 10, and the partition of DNC between the oil and water phases at each pH value was determined chemically.

None of the compounds showed any significant change in toxicity between pH 4 and pH 8, but all were less toxic at pH 10 (though the difference between pH 4 and pH 10 was not significant for dinex). The DNC occurred almost entirely in the oil phase at pH 4 and mainly as the dissociated alkali salt in the water phase at pH 8, but the decrease in toxicity was not related directly with this distribution, and it is suggested that differences in the total deposit on the egg of DNC in the oil phase and its alkali salt in the water phase are responsible. The eggs of *A. pomi* appear to react differently from those of the insects for which the alkali salt has been shown to be less toxic than the phenol, the decline in toxicity to the latter, due to a rapid decrease in the proportion of the phenol in the oil phase, occurring nearer neutrality. The results for DNC acetate are consistent with the view that its toxicity depends on the liberation of free DNC and that the latter is less toxic in rather strongly alkaline emulsions.

DICKER (G. H. L.). **The Strawberry Aphid, *Pentatrichopus fragaefolii* (Cock.), and its Control.**—*37th Rep. E. Malling Res. Sta. 1949* pp. 132–138, 9 refs. East Malling, 1950.

The author uses the name *Pentatrichopus fragaefolii* (Ckll.) for the Aphid of the genus *Capitophorus* (*Pentatrichopus*) that transmits strawberry viruses in

Britain [and is usually known as *C. fragariae* (Theo.) (*cf. R.A.E.*, A **30** 210, etc.)]. He describes its bionomics [*cf.* **26** 104 ; **30** 243] and gives an account of experiments in south-eastern England in 1949 on its control by means of parathion, which penetrates leaf tissue, so that a spray deposit on the upper surface is toxic to Aphids feeding on the lower one, and the systemic insecticide schradan (bis(bis-dimethylamino)phosphonous anhydride).

In laboratory experiments, potted plants were dipped in parathion emulsions prepared by emulsifying a solution of parathion in diacetone alcohol with the anhydrous cyclohexylamine salt of sulphonated lorol, to which a wetting agent was added, and Aphids were transferred to them. Concentrations of 0·0006 per cent. or more parathion gave complete immediate kill, and 0·00125, 0·005 and 0·02 per cent. still gave complete mortality after 2, 5 and 8 days, respectively, though not after 4, 7 and 11. No translocation of the insecticide within the plant was observed. In field tests, a commercial dispersible liquid containing 20 per cent. parathion was used at concentrations giving 0·00125–0·02 per cent. actual parathion, a wetting agent being added to some of the more dilute sprays. Infested plants were sprayed at 400–600 gals. per acre between 30th April and 13th May, and all but 0·0025 per cent. parathion without the spreader gave good control. There was little advantage in increasing the concentration above 0·005 per cent. Sprays applied on 30th April effectively eliminated the normal seasonal increase and very greatly reduced the production of winged forms.

When all but the youngest leaves of potted plants were dipped in 0·094 per cent. schradan with a wetting agent, the untreated leaves became toxic to Aphids and remained so for periods increasing from 2–3 weeks for plants dipped on 22nd July to over 15 weeks for those treated on 2nd November ; a reduced systemic effect was observed in plants dipped on 1st December. The insecticide was translocated to the young runners. In field tests on plants that had been set in the autumn of 1948, single applications between mid-May and mid-June of 0·094 per cent. schradan with the wetter at 100–150 gals. per acre effected a considerable initial reduction in the number of infested plants, and the reduction was still marked on 3rd August on those treated before the beginning of June. Spraying on 29th June caused less reduction, possibly owing to the lack of plant growth caused by drought. In another plot in which runner beds were sprayed in late June with 0·094 per cent. schradan, the infestation was effectively controlled until September, whereas spraying with 0·005 per cent. parathion was effective for only two weeks. Comparative tests showed that both sprays gave much less control on plants of the heavily infested variety Huxley than on others. Sprays of 0·094 and 0·188 per cent. schradan on 17th October caused no appreciable reduction in the number of infested plants or the average number of Aphids per leaf.

Until more is known of the toxicology of schradan, it is suggested that one application of 0·005 per cent. parathion should be made before the flowering period to control the Aphid on fruiting plants and two of 0·1 per cent. schradan, in late May and late June, to control it in runner beds. Parathion is effective only if complete cover of at least one side of every leaf is obtained, and hand spraying from both sides of the plants, using 400–600 U.S. gals. per acre, is recommended. Less complete coverage is effective with schradan, and automatic spraying at 100–150 gals. per acre should prove satisfactory.

DICKER (G. H. L.). **The Shallot Aphid, *Myzus ascalonicus* Doncaster, a Pest of cultivated Strawberries.**—*37th Rep. E. Malling Res. Sta. 1949* pp. 139–140, 1 pl., 5 refs. East Malling, 1950.

Myzus ascalonicus Doncaster [*cf. R.A.E.*, A **35** 205 ; **38** 231] was observed on strawberry in Kent for the first time in 1943. Damage was slight for the

first few years but increased considerably in 1948 and 1949 ; it appeared to be of a mechanical nature, and there was no evidence that the Aphid transmits strawberry viruses, though it has been shown experimentally to transmit those of other plants [*cf.* **35** 206 ; **37** 232]. Characters are given distinguishing *M. ascalonicus* from other Aphids known to occur on strawberry. Nothing is known of its life-cycle in the field between June and October, and sexual forms have not been observed.

Winged Aphids migrate to strawberry in October and give rise to apterae. Viviparous reproduction continues slowly throughout the winter and increases in intensity in spring. Only wingless Aphids are produced until May or early June, when a generation of winged Aphids occurs and migrates from the strawberry plants. The Aphids are few and live on the undersides of the leaves during winter, but increase and move towards the crown as new growth appears in spring, infesting the young leaves and blossom trusses. In normal seasons, no symptoms are visible until late April or early May, when distorted leaves appear. Infested plants become weak and stunted and produce small fruits of poor quality. When the plants are so injured that they cannot sustain high Aphid populations, many of the apterae move to neighbouring ones, so that patches of stunted plants, gradually increasing in area, are present in May. The plants recover rapidly when freed from the Aphids, but the crop may be greatly reduced.

Observations under differing weather conditions in 1947–49 indicated that infestation is unlikely to develop after a severe winter, particularly if the plants are exposed to low temperatures over a considerable period, but may become severe if the early spring months are exceptionally mild ; in a normal season, the areas of damaged plants will be small. Control measures are seldom necessary, but dusting with nicotine, provided that the dust reaches the crowns of the plants, and spraying with 0·005 per cent. parathion are effective.

Dicker (G. H. L.). **A Note on the Effect of DDT in Tar Oil against the Apple Capsid,** *Plesiocoris rugicollis* **Fall.**—*37th Rep. E. Malling Res. Sta. 1949* pp. 141–142, 3 refs. East Malling, 1950.

In 1947, 5 per cent. tar-distillate concentrate, alone and with 0·05 per cent. DDT, was applied to a mixed orchard of apples and pears in Kent under unfavourable conditions on 12th March, and the tar-distillate with 0·1 per cent. DDT under favourable conditions on 15th March, and the control of *Plesiocoris rugicollis* (Fall.) was estimated by counting the scarred apples at harvest. The mean percentages of scarred fruits were 59·1, 7·2 and 1·6, respectively, for one variety and 57, 10·8 and 5 for another, and most of the scars on the trees receiving DDT were slight and apparently due to adults that had migrated from other trees. As the Mirid presumably hatched during the second half of April, 0·1 per cent. DDT had remained toxic for at least five weeks. The foliage remained green until late autumn on all trees but those treated with DDT, on which the leaves were bronzed by *Paratetranychus pilosus* (C. & F.) (*Metatetranychus ulmi*, auct.) in late July, obviously owing to the killing of predacious insects. Anthocorids and the Mirid, *Blepharidopterus angulatus* (Fall.), which are the most important predators, were both numerous in the orchard, becoming active in early spring and June, respectively. If *Blepharidopterus* was killed by the DDT, this must have remained toxic for 3–4 months.

Davies (R. G.) & Eaton (J. K.). **Field Experiments on the Control of Apple Sawfly,** *Hoplocampa testudinea* **(Klug), by some synthetic Insecticides.**—*37th Rep. E. Malling Res. Sta. 1949* pp. 146–150, 5 refs. East Malling, 1950.

In preliminary experiments in Kent in 1946–48, seven synthetic organic compounds were compared with nicotine [*cf. R.A.E.*, A **34** 6, etc.] in sprays

applied against *Hoplocampa testudinea* (Klug) on apple during the egg stage (at petal-fall) or when most of the larvae were hatching. Either 0·05 per cent. Triton X-100 or 0·05 per cent. cyclohexylamine dodecylsulphate with 0·5 per cent. acetone was added to all sprays.

In 1946, 0·05 per cent. nicotine just failed to give a significant reduction in infested fruits when applied at petal-fall (10th May), and this spray, 0·2 per cent. Lethane HE60 (a solution of β-thiocyanoethyl laurate in kerosene) and 0·05 per cent. DDT all gave significant but not satisfactory control when applied as the eggs were hatching (23rd May). Lethane HE60 and DDT at petal-fall and 0·2 per cent. Lethane 384 (a mixture of β-butoxy-β′-thiocyanodiethyl ether and β-thiocyanoethyl laurate in kerosene) at petal-fall or hatching were ineffective. In 1947, 0·05 per cent. HETP (hexaethyl tetraphosphate) applied at petal-fall (16th May) or when most of the larvae were hatching (24th May) was ineffective, whereas 0·01 per cent. γ BHC (benzene hexachloride) on either date and 0·05 per cent. nicotine at petal-fall gave excellent control. It is not known whether the BHC exerted a direct ovicidal effect or whether control depended on the retention of deposits within the receptacles of the flowers until the larvae hatched.

In 1948, 0·05 per cent. parathion, 0·01 per cent. γ BHC and 0·1 per cent. chlordan, applied at petal-fall (8th May) or when the eggs were hatching (15th May), all gave very good control and were significantly more effective than nicotine applied at petal-fall, but until more is known of the effect of these insecticides on beneficial insects in the orchard, they cannot be recommended as substitutes for it.

AUSLAND (O.). **Kirsebaerflua** (*Rhagoletis cerasi* **L.**) **i Norge. En orientering om dens biologi og bekjemping.** [The Cherry Fruit-fly (*R. cerasi*) in Norway. A Contribution to its Biology and Control.]—*Meld. Plantev.* no. 5, 35 pp., 8 figs., 32 refs. Oslo, 1951. (With a Summary in English.)

Rhagoletis cerasi (L.) has long been known in Norway but was first observed on cherry there in 1935, previous records having probably been from *Lonicera* [*cf. R.A.E.*, A **31** 80]. The author reviews its synonymy, its distribution in other parts of Europe and in Norway, where it is now widespread on sweet cherry in many south-eastern districts, and the morphology of all stages, and gives an account of its bionomics, based largely on the German and Swiss literature [*cf. R.A.E.*, A **23** 225 ; **25** 3 ; etc.].

In investigations in Norway in 1948 and 1949, adults were first observed in the trees in mid-June and were present for about 50 days. Oviposition began about 20th June and was still in progress in late July, when the cherries were picked. Infestation at that time was frequently well over 90 per cent., and the numbers of eggs and larvae per 100 fruits in mid-July sometimes exceeded 200. The larvae hatched in about 12 days early in the season and in 10 days or less later ; they were present from about 3rd July and left the fruits to pupate in the soil after about three weeks, depending on temperature. Sour cherries were little attacked, except when grown with sweet varieties.

The literature on the alternative food-plants of the Trypetid is reviewed [*cf.* **26** 156 ; **31** 370 ; etc.]. In Norway, the author observed it infesting *Lonicera tatarica*, *L. xylosteum*, three other species of *Lonicera*, and *Symphoricarpus albus*, of which only the first two were of importance as food-plants. In experiments, females from *Lonicera* oviposited on cherry, and pupae were subsequently obtained, so that the existence of distinct biological races seems unlikely. Cherry trees some 200 yards from *Lonicera* did not appear to attract adults from the latter, however, so that infestation of *Lonicera* may be of little importance.

In experiments on control in 1948, the average percentages of ripe cherries infested by eggs or larvae were reduced from 61·45 to 8·4 by five applications between 10th June and 2nd July of a 20 per cent. DDT emulsion concentrate at 0·5 per cent. and from 48·7 to about 29–30 by four between 1st and 21st or 10th and 25th June. Smaller numbers of sprays of another DDT preparation were less effective, but they were tested against a very heavy infestation. In 1949, a spray of 0·5 per cent. Gesarol (10 per cent. DDT) on 21st June, when oviposition was beginning, gave considerable initial reduction in adults and eggs, but infestation increased after about a fortnight and was little less than in the controls by mid-July. In laboratory tests, two proprietary phosphorus insecticides gave promising results against adults placed in sprayed jars, but lost their effectiveness in about four days. They were also toxic to the eggs, and a field test indicated that two applications might give practical control. DDT is preferred, however, as being less dangerous for man. It should be applied 8–10 days after the adults have appeared in the trees and subsequently at intervals of 10–14 days.

FJELDDALEN (J.) & DAVIKNES (T.). **Veksthusspinnmidder resistente mot thiofosformidler funnet i Norge.** [Greenhouse Spider-mites resistant to Parathion found in Norway.]—*Gartneryrket* 1952 no. 13 repr. 8 pp., 7 refs. Oslo, 1952. (With a Summary in English.)

Parathion (E 605 [*cf. R.A.E.*, A **40** 193, etc.]) has been used against *Tetranychus telarius* (L.) (*althaeae* v. Hanst.) in Norway with success since 1947, but in September 1951, it was observed to give low mortality of the mite on roses in certain greenhouses. The owner stated that he had used parathion for several years and that since April 1951, sprays of 0·05 per cent. of a 35 per cent. concentrate had been applied three times a month. Infestation was sporadic, persisting on individual plants or groups of plants, indicating the development of resistance in certain colonies of the mite. In tests, sprays of the same concentrate at 0·05 and 0·1 per cent. gave only 15–20 per cent. mortality and when these were repeated a week later the mites still persisted in patches after three days on plants that had been heavily infested. Treatment with parathion smoke tablets gave 45 and 90 per cent. mortality after 1 and 3 days, respectively, but heavy pockets of infestation still remained. An azobenzene smoke was tested in one greenhouse, but gave no better results than the parathion sprays and injured the blooms. It is concluded that resistant colonies of *T. telarius* had developed as a result of the prolonged use of parathion [*cf. R.A.E.*, A **38** 426 ; **39** 313], as has also been reported on rose in Holland.

Other acaricides were subsequently tested against the resistant mites. In trials with systemic materials, sprays of 0·1 per cent. Pestox 3, which contains 66 per cent. schradan (octamethyl pyrophosphoramide), and 0·05 per cent. Systox, containing 50 per cent. active ingredient [O, O-diethyl O-(2-(ethylmercapto)ethyl) thiophosphate], gave 94 and 100 per cent. mortality, respectively, in four days, in comparison with 15 per cent. for parathion, and 95·9 and 98·6 per cent. after 23 days. When the soil was watered with 0·125 per cent. Pestox 3 and 0·075 per cent. Systox at about 7·5 pints per sq. yard, 75 per cent. mortality was obtained after four days and 72·8 and 83 per cent. after 23. Systox at 0·04 per cent. was less effective. The inferiority of this method of application may have been due to poor uptake by the roots or to washing away of the toxicant by subsequent watering.

In tests of other materials, smoke tablets of tetraethyl dithiopyrophosphate (Bladan 393) gave very high mortality of the mites and their eggs without injuring the plants, and sprays of 0·4 per cent. Ovotran (p-chlorophenyl p-chlorobenzenesulphonate), 0·125 per cent. Dimite (DMC) (1, 1-bis(p-chlorophenyl)ethanol) and 0·12 per cent. EPN (O-ethyl O-p-nitrophenyl benzenethiophosphonate) gave about 70, 90 and 45 per cent. mortality in 3 days and 95,

95 and 55 per cent. after a week ; EPN is closely related chemically to parathion, which may have accounted for its low toxicity to the mites.

VAN DINTHER (J. B. M.). *Eriophyes gracilis* **Nal., als verwekker van gele bladvlekken op framboos.** [*Phyllocoptes gracilis* as a Cause of yellow Leaf Spots on Raspberry.]—*Tijdschr. PlZiekt.* **57** pt. 3 pp. 81–94, 2 pls., 2 graphs, 4 refs. Wageningen, 1951. (With a Summary in English.)

Since the Eriophyid, *Phyllocoptes* (*Eriophyes*) *gracilis* (Nal.), and various virus diseases both cause yellow spots on the leaves of raspberry in Holland, the bionomics of the mite and the symptoms caused by it were studied in 1950 to facilitate identification. The original description of the mite is quoted. The numbers present on the yellow and normal green areas of infested leaves in late July averaged 8·9 and 0·3 per sq. cm., respectively ; the difference was highly significant and there was a significant correlation between the size of the yellow areas and the numbers of mites on them. The mites overwintered between the petioles and axillary buds, or between the outer bud scales, and migrated to the lower surfaces of the leaves in May, causing the appearance of spots. Their numbers increased during the summer, resulting in an increase in the number and size of the spots, and reached a maximum at the end of August, when 100–200 mites per leaf were frequently found. As the mites spread to the new canes, the infestation gradually died out on the old ones. The mites migrated to their winter quarters in September, and as many as 300–800 per bud were found in early November. The hibernating population included a few nymphs, the others being adult females. They remained dormant throughout the winter, but quickly became active when transferred to a temperature of 20°C. [68°F.]. This temperature was reached in the field about the second half of April, after the buds were already open. Infested leaves showed either small yellow spots with definite margins, occurring in variable numbers, or yellow areas of varying size with indefinite margins, occurring usually near the edges or along the main veins, and it was possible to distinguish these from symptoms of the virus type. The mites caused no injury to the fruits [*cf. R.A.E.*, A **35** 130, etc.], and since they were rarely numerous enough to affect the growth of the plants, control measures are considered unnecessary.

KRONENBERG (H. G.) & DE FLUITER (H. J.). **Resistentie van frambozen tegen de grote frambozenluis** *Amphorophora rubi* **Kalt.** [Resistance in Raspberries to *A. rubi*.]—*Tijdschr. PlZiekt.* **57** pt. 4 pp. 114–123, 8 refs. Wageningen, 1951. (With a Summary in English.)

Since *Amphorophora rubi* (Kalt.) is the Aphid most likely to be of importance as a vector of raspberry viruses in Holland [*cf. R.A.E.*, A **40** 100], 26 varieties of raspberry and 19 seedlings, mostly hybrids of them, were tested in 1949–50 for resistance to infestation by it. The results are given in detail and showed that two varieties were almost completely resistant and that resistance was apparently inherited by two crosses from one of them.

WALRAVE (J.). **Een eenvoudige methode voor de localisatie van insecten op bepaalde bladeren van een plant.** [A simple Method of confining Insects on selected Leaves of a Plant.]—*Tijdschr. PlZiekt.* **57** pt. 4 pp. 126–127, 1 pl., 4 refs. Wageningen, 1951. (With a Summary in English.)

The cage described consists of a short hollow cylinder of plastic or glass with a flat glass cover, which are placed on the upper surface of the leaf, and a plastic ring of the same diameter as the cylinder, which is arranged directly beneath it on the underside. A piece of watch spring, fixed at one end to the ring, curves round the edge of the leaf and closes on the cover glass, holding

the complete assembly in position. The apparatus weighs very little, caused no harm to leaves to which it was attached for a week, and is very suitable for use with Aphids.

HILLE RIS LAMBERS (D.). **De overwintering van de perzikbladluis** (*Myzus persicae* **Sulzer**) **als ei.** [The Overwintering of the Peach Aphid (*M. persicae*) in the Egg Stage.]—*Tijdschr. PlZiekt.* **57** pt. 4 pp. 128–129. 1 ref. Wageningen, 1951. (With a Summary in English.)

The author recapitulates his earlier conclusion that peach was the only plant on which *Myzus persicae* (Sulz.) successfully overwinters in the egg stage in Holland [*R.A.E.*, A **34** 367] and describes the circumstances in which it was subsequently found that overwintering in the egg and development of the spring generation also take place there on *Prunus serotina* [**39** 360]. The observations indicated that the fundatrices occur almost entirely on spurs on the trunks of older trees. The significance of this discovery is pointed out.

It is also recorded that damage by the spring generations was observed on *P. nana* in a botanical garden in Switzerland, and that recent investigations in Canada have not confirmed overwintering and development of the spring generations there on *P. nigra* in the open [*cf.* **31** 129].

BLUNCK (H.). **Zur Kenntnis der Hyperparasiten von** *Pieris brassicae* **L. 3. Beitrag : *Hemiteles simillimus* Taschb. nov. var. *sulcatus*. Kennzeichen und Verhalten der Vollkerfe.** [Contributions to the Knowledge of the Hyperparasites of *P. brassicae*. Third Contribution : *H. simillimus* var. *sulcatus*, n. Characters and Behaviour of the Adult.]—*Z. angew. Ent.* **32** pt. 3 pp. 335–405, 15 figs., 25 refs. Berlin, 1951.

In this third part of a series [*cf. R.A.E.*, A **35** 351 ; **36** 406], the author describes further investigations in western and northern Germany in 1945–46 and 1950 on the parasites of *Apanteles glomeratus* (L.), a parasite of *Pieris brassicae* (L.). Many thousands of cocoons of *A. glomeratus* were collected in cabbage fields, and records were made of the parasites that had already emerged from them (identified from the exit holes and internal remains) and those that emerged in the laboratory. The results are shown in tables, and those for 1945–46 are compared with the averages for 1930–43 [**35** 352]. Among the Ichneumonids, there was a considerable reduction in the proportion of *Hemiteles nanus* (Grav.) (*fulvipes* Grav.) and increases in those of *Leptocryptus brevis* Thoms. and a variety of *Hemiteles simillimus* Taschb. described from adults of both sexes as *H. simillimus* var. *sulcatus*, n. The author reared this variety only from *A. glomeratus*, but considers that it may also have other hosts. It was obtained from several localities in Germany and also from Poland (near Danzig) and the Ukraine.

In laboratory observations at an average temperature of 17·5°C. [63·5°F.], males of var. *sulcatus* flew readily, but the females were less active and remained hidden for long periods. They survived for an average of 1–2 months when given food and water, for at least a week with water but without food, and for only 1–2 days without either. They fed on sugar, as crystals or dissolved in water, and the females also on the body fluid that exuded from host larvae pierced in their cocoons with the ovipositor. The likelihood of the larvae surviving these attacks is discussed ; only rare exceptions did so in the laboratory. The alimentary and reproductive organs of var. *sulcatus* and the processes of pairing and oviposition are described in detail. Eggs laid by unfertilised females gave rise to males only. The ratio of males to females was normally about 5 : 3. Both sexes became sexually mature about a day after emergence and the males were attracted only to unmated females, though

they were capable of fertilising more than one. The females laid their eggs singly, one in each host cocoon, but some cocoons were visited many times. One that was enclosed for 26½ hours with two unfertilised females was subsequently found to contain 16 eggs. Deposition of an egg was frequently preceded by lengthy probing with the ovipositor, and as only one larva develops in each cocoon and dissected cocoons often contained several damaged eggs it is suggested that the female destroys any eggs present before ovipositing. In the presence of a constant supply of cocoons, females normally laid 1–2 eggs a day, the maximum total deposited by any one individual being 38 and the average about 24. It could not be shown with certainty that unfertilised females were less prolific than others, but absence of host cocoons reduced egg production. Physiological changes accompanying senescence are described.

GÖSSWALD (K.). **Zur Biologie, Ökologie und Morphologie einer neuen Varietät der Kleinen Roten Waldameise :** *Formica minor pratensoides.* [On the Biology, Ecology and Morphology of a new Variety of the Small Red Forest Ant.]—*Z. angew. Ent.* **32** pt. 3 pp. 433–457, 4 figs., 7 refs. Berlin, 1951.

Observations in a spruce forest near Würzburg in 1944 resulted in the discovery of a new variety, described as var. *pratensoides*, n., of the small red forest ant, *Formica rufa rufopratensis minor* [*cf. R.A.E.*, A **35** 212]. Morphological characters distinguishing the workers, males and females from those of other forms of *F. rufa* are given, and investigations on its bionomics are recorded. Its significance in controlling forest pests was unknown, but it was unlikely to prove suitable for artificial colonisation in forests because of its tendency to found new nests, rather than build up extensive colonies, and the unwillingness of the workers to adopt introduced queens of more beneficial forms.

GODAN (D.). **Die Miniertätigkeit der Larven des Rapserdflohes (*Psylliodes chrysocephala* L.).** [The mining Activity of the Rape Flea-beetle (*P. chrysocephala*).]—*Z. angew. Ent.* **32** pt. 3 pp. 458–475, 19 figs., 19 refs. Berlin, 1951.

Larvae of the flea-beetle, *Psylliodes chrysocephala* (L.), bore repeatedly into the stalks of rape and turnip rape in Germany and are particularly injurious to the growing plants [*cf. R.A.E.*, A **30** 208]. Field and laboratory investigations on this mining activity showed that larvae in the first instar usually entered the leaf-stalk from the upper surface, which is free from vascular bundles, and normally selected a point of entry where the outside surface offered some support. Those in the second and third instars entered on any side of the leaf-stalk. The larvae mined towards the tip of the leaf, except at the end of the third instar, when they bored towards the main stem. The mines were tortuous and consisted of a central tunnel with one or more branches at right-angles. Some of these had no outlet while others terminated in small holes in the wall of the stalk. Moulting occurred in the neighbourhood of these holes, more of which were cut by larvae kept at higher temperatures, and it is considered that their function is to admit oxygen into the mines. The mining activity and rate of growth of the larvae and the quantity of food consumed decreased as they grew older. It was normal for them to leave one stalk and enter another in search of fresh food. In doing so they left characteristic trails on the surface of the plants.

Larvae in the first instar did not damage the vascular bundles, but remains of these were found in the excreta of older individuals, even when no visible damage had been caused. The larvae normally pupate in the soil, but in the

laboratory, where no soil was provided, they frequently did so in small chambers in the stalks, which are described.

SCHENKER (P.). **Die Graseule** (*Charaeas graminis* **L., Lepidopt.) als Grünlandschädling im Emmental.** [*C. graminis* as a Pest of Pasture in the Emmental.] —*Landw. Jb. Schweiz* **64** pt. 2–3 pp. 251–295, 15 figs., 50 refs. Berne, 1950.

An outbreak of *Charaeas graminis* (L.) was observed in an alpine pasture in the upper Emmental, Switzerland, in June 1952. The damage to the grass had already passed its peak, and a large part of the area had been almost denuded, though other pasture plants remained. Investigations on the bionomics and control of this Agrotid, all stages of which are described, were made in that and the two following years, when damage was much less. These showed that adults emerged from field-collected pupae between late June and mid-August, and that the ratio of males to females was about 3 : 2 [*cf. R.A.E.*, A **30** 543]. Pairing occurred mainly in the morning, and oviposition chiefly in the evening. The number of eggs laid varied directly with the size of the females, and averaged 250–300. They were dropped during flight, usually within two days of pairing.

The eggs do not normally hatch until the following spring [*cf.* **27** 122 ; **30** 543], and no larvae were found in the field in the autumn of 1942, but in that and the following year a few hatched in autumn from eggs kept at room temperature, and still more in 1943 from eggs exposed for 5 or 12 days in November to −3°C. [26·6°F.]. The percentage hatch among eggs collected in the field in November 1942 and allowed to overwinter under natural conditions was 72 ; hatching occurred between February and March. It was somewhat later in cage tests in 1944, and was shown in that year to vary with the temperature, no larvae hatching on days when the minimum lay below freezing point. Migrating larvae were frequently reported in 1942 and 1943, and many were found trapped in cart ruts, hoof prints and other depressions in the soil. In feeding tests, grasses of numerous species were accepted, with no particular preferences, but no other pasture plants were attacked, even when no alternative food was offered. Studies on the amount of food consumed, the results of which are given in tables, showed that larvae that gave rise to females consumed more than males, but they pupated after an average of 96 days, as compared with 93 for males ; the pupal stage averaged about 25 days for both sexes. The amounts of grass consumed were low for young larvae, though considerable damage was caused to the growing tips, but were much greater for larvae in the final instar.

The natural enemies observed included various insects that were predacious on the eggs or larvae. The eggs were parasitised by *Trichogramma* sp., which was not common, while *Microplitis tristis* (Nees), *Echinomyia magnicornis* Zett. and *Winthemia quadripustulata* (F.) were reared from the larvae, and *Ichneumon ligatorius* Thnb. (*gradarius* Wesm.) [*cf.* **27** 122] and *Gonia flaviceps* Zett. from the pupae, in addition to other species of little or no importance. *I. ligatorius* was bred from 24 and 16–42 per cent. of the pupae collected in 1942 and 1943, respectively, and *G. flaviceps* from 24 and 13–20 per cent. *Hexamermis* sp. emerged from many of the larvae (about one-third of those collected in June 1942), and both larvae and pupae were attacked by the fungus, *Isaria farinosa*. Polyhedral disease and an unidentified disease apparently of bacterial origin were observed among the larvae in 1943. The percentages of field-collected larvae and pupae that gave rise to adults in the laboratory were 4–47 in 1942 and only 2–12 in 1943.

Experiments on the control of *C. graminis* in 1942 showed that dusting an area of pasture with DDT at the end of July caused no mortality of adults and that broadcasting calcium cyanamide or lime in November killed few eggs. In a small-scale test in April 1943, calcium cyanamide, kainit and DDT dusts and sprays gave good control of the larvae and were the best of several materials

tried. In a test over a larger area, a DDT spray was applied in mid-May, and many dead larvae but no living ones were found in grass samples examined six days later.

In 1942 and 1943, *Tholera popularis* (F.) was injurious to grass in a restricted area of the same locality, but at a lower altitude. Respects in which its morphology and bionomics differ from those of *C. graminis* are noted. Calcium cyanamide gave unsatisfactory control, but the larvae disappeared following a DDT spray applied in May 1943, though natural enemies may have been partly responsible.

GALLAY (R.). **Stations fédérales d'essais viticoles, arboricoles et de chimie agricole, à Lausanne et à Pully, sous-station en Valais, Conthey-Sion-Vétroz. Rapport d'activité 1949.**—*Landw. Jb. Schweiz* **64** pt. 8 pp. 729–861, 12 graphs. Berne, 1950.

This report contains a section (pp. 788–799) dealing with work on pests of vines and fruit trees in French Switzerland and the Ticino in 1949. Further experiments with parathion in sprays for the control of *Clysiana* (*Clysia*) *ambiguella* (Hb.) and *Polychrosis botrana* (Schiff.) on grape vine gave results comparable with those of the previous year [*cf. R.A.E.*, A **40** 53], but its use for this purpose has not been sanctioned in Switzerland, as there is some possibility of toxic residues persisting in vine products. Emulsion or wettable powder sprays of parathion applied on 5th April gave good control of the apple blossom weevil [*Anthonomus pomorum* (L.)] on apple and were as effective as wettable DDT. They were also applied at bud-burst and compared with dormant treatments (tar distillate or dinitro-o-cresol) for effectiveness against Lepidopterous larvae on fruit trees, including *Argyresthia ephippella* (F.) on cherry, *A. cornella* (F.), *Chloroclystis rectangulata* (L.), *Spilonota* (*Tmetocera*) *ocellana* (Schiff.) and *Argyroploce variegana* (Hb.) on apple and *Tortrix* (*Cacoecia*) *rosana* (L.) on pear. Under favourable conditions, parathion was equal or superior to the winter treatments, but it was evident that applications needed careful timing. The addition of parathion to DDT sprays applied against *Cydia* (*Laspeyresia*) *pomonella* (L.) on apple, to prevent injurious outbreaks of mites, was further investigated. In one orchard in which *Bryobia praetiosa* Koch, *Paratetranychus pilosus* (C. & F.) and *Tetranychus telarius* (L.) (*althaeae* v. Hanst.) were rare in spring, spraying with DDT and wettable sulphur was not followed by an injurious increase in their numbers, but in others, all trees sprayed with DDT suffered serious attacks. When parathion was added, populations of *Bryobia* and *Paratetranychus* remained low and mass outbreaks of *T. telarius* occurred only in late September or early October, after spraying had ceased. Repeated winter treatment had almost eradicated *Quadraspidiotus perniciosus* (Comst.) from some areas, but, owing to favourable weather, infestation increased again in 1949. A list is given of 59 species and varieties of forest and ornamental trees on which the scale was observed to develop and reproduce in experiments.

MELIS (A.). **Necessità di colpire gli individui della generazione carpofaga per ottenere risultati concreti nella lotta contro la tignola dell'olivo** (*Prays oleellus* **F.**). [The Necessity of attacking the Individuals of the fruit-infesting Generation for obtaining positive Results in the Control of the Olive Moth (*P. oleellus*).]—*Ann. Sper. agr.* (N.S.) **2** no. 5 pp. 701–725, 7 refs. Rome, 1948. (With a Summary in English.)

The author reviews the bionomics of *Prays oleellus* (F.) on olive in Italy and points out that the leaf-infesting (winter) generation causes little injury to the trees and cannot be controlled so completely as to prevent subsequent increase of population and damage to the fruits, and the flower-infesting (first)

generation also has little effect on the crop, as only a small proportion of the flowers normally set fruit. The main damage is caused by larvae of the second generation, which infest the fruits themselves, and control should therefore be directed against them [*cf. R.A.E.*, A **36** 141]. The loss of crop caused by this generation is shown to be greater and more prolonged than previously thought [*cf.* **36** 193], and an account is given of experiments near Florence in 1946 [**36** 194], from which it is tentatively concluded that spraying against the second generation is beneficial. Further tests were carried out in 1947, when unstated arsenicals were applied to the trees in mid-June, half of each crown being sprayed and the other half left untreated. Oviposition had begun a few days previously. Mortality of the larvae on the sprayed portions was high, but there was little difference in fruit infestation. It is thought that the treatment was applied too late, as a subsidiary test indicated that larvae that hatch from eggs present at the time of spraying are apparently able to enter the young fruits normally, although the eggs were covered with a heavy arsenical residue. This renders the timing of the sprays of critical importance.

BELLIO (G.). **Prove di fumigazione invernale di alberi da frutto a foglie decidue contro la *Parlatoria oleae*, altre cocciniglie ed altri insetti.** [Tests of Winter Fumigation of deciduous Fruit Trees against *P. oleae*, other Coccids and other Insects.]—*Ann. Sper. agr.* (N.S.) **3** no. 2 pp. 415–431, 3 pls., 2 figs., 2 refs. Rome, 1949. (With a Summary in English.)

Parlatoria oleae (Colv.) is a serious pest of deciduous fruit trees in southern Italy, and experiments were carried out near Naples in 1947–48 on the effectiveness against it of winter fumigation with hydrocyanic acid gas, which had not previously been tested for that purpose. The gas was generated by the pot method, from sodium cyanide, hydrochloric acid and water used in the proportion of 1 : 1·5 : 2 (by weight for the cyanide and by volume for the acid and water), and exposure was for about an hour. Fumigation was carried out in December or January, as weather permitted, under tents, and over 1,000 apple and peach trees were treated. The dosages employed were those recommended for *Citrus* in the tables of the author [*R.A.E.*, A **22** 492] and Woglum [**11** 535], increased in some cases by 20 per cent. or more. The apple trees were treated singly, but the peaches were fumigated two or more together under long tents, and the normal dosage as calculated from the longer side of the tent then gave an effective dosage 20 per cent. greater than for trees treated singly. Temperatures during the work ranged from 6 to 17°C. [42·8–62·6°F.] and relative humidities from 49 to 89 per cent., and operations were frequently interrupted by rain. Constant wind caused much leakage of gas at the bases of the tents, and they had frequently to be secured by piling earth on them.

The results were first estimated about 20 days after fumigation, when mortality was complete on 54·1 per cent. of the trees given the normal dosage and 79·1 per cent. of those given one 20 per cent. greater, and averaged 88·3 and 95·7 per cent. on all trees of those two groups, respectively. Effectiveness decreased from the interior of the tree towards the periphery and still more towards the base. A further examination was made on 29th July, when one of the trees given the normal dosage was the only one to show infestation. Only 1 per cent. of apple fruits were infested, and those by only 1–2 scales each, as compared with 66 per cent. for trees sprayed with lime-sulphur in January.

Observations were also made on the effect of the treatment on other insects on the trees. *Quadraspidiotus* (*Aspidiotus*) *perniciosus* (Comst.), which was present in small numbers on both apple and peach [*cf.* **37** 446], and *Eriosoma lanigerum* (Hsm.) on apple were both almost eradicated (the latter even by the normal dosage and with no mortality of endophagous parasite larvae), but

there was no effect on the eggs of other Aphids or of mites or on larvae of *Aegeria* (*Conopia*) *typhiaeformis* (Bkh.) beneath the bark or larvae of *Zeuzera pyrina* (L.) in their galleries in the wood on apple. Mortality of *Ceroplastes rusci* (L.) on two fig trees fumigated under a single tent for 1½ hours in January at the normal dosage increased by 20 per cent. reached 99 per cent. after 20 days.

It is concluded that winter fumigation against *P. oleae* is practicable and effective. The tents should be of close material, to resist the wind, and the trees should be fumigated before being pruned, to avoid damage to the tents by snags. The dosages used should be 20 per cent. greater than those for *Citrus*, and a revised dosage table for deciduous fruit trees is appended.

LANZA (F.). **Sulla conservazione delle castagne destinate all'esportazione. Nota I. Ricerche sperimentali sulla disinfestazione chimica.** [The Preservation of Chestnuts for Export. Note I. Experimental Investigations on chemical Disinfestation.]—*Ann. Sper. agr.* (N.S.) **3** no. 4 pp. 1029–1047, 4 figs., 15 refs. Rome, 1949. **Nota II. Ricerche sperimentali di lotta contro le infezioni crittogamiche (disinfezione chimica). L'ossido di etilene ed il bromuro di metile come fungicidi.** [Note II. Control Experiments against cryptogamic Infections (chemical Disinfection). Ethylene Oxide and Methyl Bromide as Fungicides.]—*Op. cit.* (N.S.) **4** no. 2 pp. 321–328, 12 refs. 1950. (With Summaries in English.)

Curculio (*Balaninus*) *elephas* (Gylh.) and *Cydia* (*Carpocapsa*) *splendana* (Hb.) are stated in the first note to be serious pests of chestnuts for export in Italy. The usual method of control adopted is to soak the chestnuts for 45 minutes in water heated to 50°C. [122°F.], which kills larvae of both species in them, but reduces their quality and favours attack by fungi. Experiments were therefore carried out in 1948 on the use of fumigants [*cf. R.A.E.*, A **17** 328, 493 ; **27** 359]. *Cydia* is fairly easy to control in this way, since the entrance holes made by the larvae remain open, but *Curculio* is more difficult, as the holes, which are made at the base, close up, thus impeding penetration by gases. The weights of fumigant used in the tests, which were not on a large scale, are given per 100 cu. ft. The temperature was 19–24°C. [66·2–75·2°F.] and the relative humidity 72–95 per cent. The chestnuts used were infested by one or both of the insects.

Carbon bisulphide gave varying results, fumigation with 8 oz. for 20 hours at atmospheric pressure giving complete mortality of both insects together, but 8 or 12 oz. for 18 hours proving ineffective against *Curculio* alone. When some of the *Curculio* larvae had left the chestnuts, so that exit holes were present, treatment with 8 oz. for 18 hours killed the remaining larvae. With an initial vacuum of 28 cm. mercury, fumigation with 8 oz. carbon bisulphide for 9 hours gave complete mortality of *Cydia*, and at one of 70 cm., 12 oz. for 5·5 hours gave complete mortality of *Curculio*. Fumigation with ethylene oxide at 7 oz. for 5·5 hours with an initial vacuum of 66 cm. and with a mixture of 17 oz. ethylene oxide and 1·5 oz. carbon dioxide for 2 hours at one of 26 or 62 cm. proved effective against *Cydia*, and 9 oz. methyl bromide for 4 hours at atmospheric pressure against both species together. Carbon tetrachloride was ineffective at the rates used.

It is reported in the second note that a sample of the chestnuts fumigated with methyl bromide was shipped to the United States, where it was found to be of high quality, free from living insects, and less infected by fungi than was usual. Methyl bromide is known to have fungicidal effects, and when tested, both it and ethylene oxide applied as fumigants controlled fungi on chestnuts.

The concentrations effective against the insects were satisfactory if the exposure periods were prolonged.

Di Prima (S.). **Su alcuni effetti nocivi dell'esaclorocicloesano per le piante.** [Some harmful Effects of Benzene Hexachloride on Plants.]—*Ann. Sper. agr.* (N.S.) **4** no. 2 pp. 307–320, 6 figs. Rome, 1950. (With a Summary in English.)

An account is given of tests in Italy in 1949 in which seeds of 12 crop plants were sown in small pots with a capacity of 100 cc. in soil mixed with a proprietary product containing BHC (benzene hexachloride) at rates corresponding to about 270–3,600 lb. technical BHC per acre, and observations were made on subsequent germination and growth, in comparison with no treatment. The lowest rates per acre that reduced germination and (in brackets) growth significantly were 810 lb. (810 lb.) for oats and lucerne, 2,160 lb. (1,450 lb.) for broad bean [*Vicia faba*], about 1080 lb. (1,080 lb.) for wheat and peas, 1,800 lb. (540 lb.) for maize, 810 lb. (540 lb.) for barley, 1,080 lb. (540 lb.) for rye, 1,080 lb. (810 lb.) for soy bean, 270 lb. (270 lb.) for sorghum, about 3,600 lb. (1,800 lb.) for castor [*Ricinus communis*], and 1,080 lb. (1,080 lb.) for vetch [*Vicia*], and damage increased almost rectilinearly with dosage at the harmful rates. Results of the same order were obtained in petri dishes and in larger pots, in which higher rates were also tested, though the injurious levels were affected by the changes in concentration that resulted from mixing with smaller and greater relative volumes of soil, respectively. Some of the abnormalities of growth observed are described. Rates of application above 1,080 lb. per acre are unlikely to be used in practice, so that soil treatment with BHC will not normally cause injury to many plants.

Martelli (G. M.). **Sperimentazione orientativa antidacica con insetticidi organici clorurati distribuiti sul terreno o in esso incorporati.** [Tentative Trials of Olive-fly Control by distributing organic chlorinated Insecticides on the Soil or incorporating them in it.]—*Ann. Sper. agr.* (N.S.) **4** no. 1 pp. 153–164. Rome, 1950. (With a Summary in English.)

Small-scale experiments were begun in the laboratory in Italy in 1947 on the value of soil treatment with dusts of DDT and BHC (benzene hexachloride) against *Ceratitis capitata* (Wied.) and *Dacus oleae* (Gmel.). The dusts contained 5 per cent. DDT or BHC and were applied to soil in pots at a rate corresponding to about 63 lb. per acre.

In a preliminary test, larvae of *C. capitata* were allowed to drop from peaches on to soil dusted with DDT ; subsequent pupal mortality was 25·2 per cent., as compared with 4·7 per cent. for no treatment. When tubes containing puparia were placed upright in soil that was then dusted with the two insecticides, the mortality among emerging adults was 72·5 per cent. for DDT, 44·3 per cent. for BHC and 0 in the control.

In similar tests with *D. oleae*, larvae that fell from olives on to soil dusted with DDT or BHC entered it without loss, sometimes after crawling on the surface for considerable periods, and all pupated. Pupal mortality was 26·4–35·1 per cent. for DDT and 21·9–30·3 per cent. for BHC, as compared with no treatment. When the BHC dust was mixed with the upper inch of soil, previously moistened, and larvae allowed to enter over periods of 12 hours on that and the succeeding six nights, the percentage pupal mortality fell from 64 for the first night to 8·3 for the fifth, and was 36·1 for the last ; it averaged 33·7 for the whole test. The increase in mortality towards the end is attributed partly to experimental error and partly to the low vigour of the larvae that leave the fruits last. In a final test, 100 full-fed larvae were placed in November 1948 on soil into the upper inch of which BHC had been incorporated. All entered it rapidly, and in

the following March, after exposure in the open over winter, 8 empty puparia, 39 dead pupae and the remains of 3 partly decomposed puparia were recovered, as compared with 45, 13 and 6, respectively, and 5 living pupae in the control. Mortality soon after the soil was entered and subsequent decomposition are thought to have contributed to the large numbers of missing individuals, though some may have emerged early enough for the empty puparia to have decomposed. The results of this last test are considered promising.

PUSSARD (R.). **Observations biologiques sur** *Rhytidoderes plicatus* **Ol. (Col. Curculionide).**—*C.R. Soc. Biol.* **145** no. 1–2 pp. 37–39, 4 refs. Paris, 1951.

Further observations on the bionomics of *Rhytidoderes plicatus* (Ol.), a weevil that injures cruciferous crops in Bouches-du-Rhône, France [*cf. R.A.E.*, A **27** 458], showed that the adults are present throughout the year, but are most numerous during November–March, and that newly emerged ones are common during June–August. In June, the adults feed on cruciferous weeds and are to be found sheltering beneath them and in other protected situations, but from July they attack cruciferous crops, notably cauliflower. In the laboratory, they survived for 15–16 months. Mating and slight feeding can both take place at temperatures as low as 2°C. [35·6°F.]. Eggs are laid chiefly in autumn and winter, and females kept in isolation after pairing laid fertile eggs for at least 90 days. The total numbers deposited over a period of 4–8 months by single females caged with males and adequate food varied from about 150 to 1,250. The maximum number deposited during 24 hours was 50, but at low temperatures, only one or two were laid during this period. The duration of the egg stage varied from 18 days at 25°C. [77°F.] to 97 at a mean temperature of 8·7°C. [47·66°F.], but varied by 1–30 days among eggs laid on the same day, the difference being greater in cold weather. The eggs hatched normally when kept under water. The larvae feed on the roots of crucifers and are most numerous during September–February, though they are present throughout most of the year. In experiments, they burrowed readily into a stony calcareous clay soil and penetrated as deep as 24 ins. in light alluvial soil. Pupation takes place, chiefly in April–August, in an earthen cell.

A few of the adults were parasitised by *Rondania cucullata* R.-D. The pupal stage of this Tachinid lasted 47 days at a mean temperature of about 10°C. [50°F.], and the adults survived for at least 15 days in the laboratory.

FRAPPA (C.). **Sur l'introduction et l'acclimatement à Madagascar d'***Anaphoidea nitens* **Gir., insecte auxiliaire parasite du charançon de l'eucalyptus.**—*Bull. agric. Madagascar* **2** no. 17 pp. 14–19, 3 figs., 2 refs. Tananarive, 1950.

Gonipterus scutellatus Gylh. was observed on *Eucalyptus* in Madagascar for the first time in May 1948. Since it appeared likely to spread and multiply rapidly under the local climatic conditions, which would permit four generations a year, its Mymarid parasite, *Anaphoidea nitens* Gir., was introduced from Mauritius, where it had given excellent control of the weevil [*cf. R.A.E.*, A **39** 365, etc.]. Three consignments of parasitised egg-pods were received in September, and the parasite was reared in the laboratory. Its life-cycle lasted 16–18 days, the ratio of males to females was 1 : 2 and the females deposited 25–40 eggs each. Several hundred parasites were liberated at the site of the main infestation at Périnet in October, and subsequent examination of egg-pods from that area showed about 35 per cent. parasitised three months later, when 1–15 parasites emerged from each parasitised egg-pod, and 67 per

cent. in March 1949, when up to 16 emerged from each. Laboratory rearing of the parasite was being continued.

CHAMBERLIN (F. S.). **Source of early Aphid Infestations in shade-grown Tobacco.**—*Florida Ent.* **33** no. 1 pp. 16–17. Gainesville, Fla., 1950.

Small populations of Aphids, chiefly *Myzus persicae* (Sulz.), have been found each spring since 1947 in tobacco plant beds in the areas in Florida and Georgia in which shade-grown tobacco is cultivated and have been a source of serious infestation of tobacco in the field. As the soil is sterilised before the seed is sown, the infestation is apparently due to migrants that penetrate the layers of shade-cloth surrounding and covering the beds. After the tobacco harvest, climatic conditions, disease and predacious insects, mainly *Cyrtopeltis lurida* (Gibson) (*varians*, auct.), practically eliminate the Aphids on any surviving tobacco plants by the end of September, and the plants themselves are usually killed by frost during the winter, but varying populations of *M. persicae* reproduce viviparously throughout the autumn and winter on cruciferous crops, other cultivated plants and some wild plants.

In a test to ascertain whether *M. persicae* can alternate between tobacco and crucifers, individuals of a strain that had developed for many successive generations on tobacco in 1948 were confined on cabbage, collard and turnip, the three main winter food-plants, that had been freed from insects. Infestation developed readily on all three, with the highest populations on turnip, and when Aphids from each of the three crops were transferred to tobacco seven weeks later, heavy infestations developed in each case and stunting of the plants resulted.

It is concluded that cultivated crucifers are the most probable source of infestation in the tobacco plant beds.

RIHERD (P. T.). **Biological Notes on *Anagyrus antoninae* Timberlake (Hymenoptera-Encyrtidae) and its Host *Antonina graminis* (Maskell) (Homoptera-Coccidae).**—*Florida Ent.* **33** no. 1 pp. 18–22, 1 fig., 2 refs. Gainesville, Fla., 1950.

Infestation of Rhodes grass (*Chloris gayana*) by *Antonina graminis* (Mask.) in Texas increased considerably between 1945 [*cf. R.A.E.*, A **38** 493] and 1948, when a further survey was made, and the Coccid was also observed on grasses of 28 other species, including sugar-cane, a list of which is given. In January 1949, the native parasites, *Orgilus gelechiavorus* Cushm., *Polynema longipes* (Ashm.), *Xanthoencyrtus* sp., *Charips* sp. and *Meromyzobia* sp., were reared from infested Johnson grass (*Sorghum halepense*), and in March 1949, examples of *A. graminis* parasitised by *Anagyrus antoninae* Timb. were received from Hawaii [*cf.* **39** 400] ; *Marietta graminicola* Timb., a secondary parasite, was also reared from the Hawaiian material.

The method by which *A. antoninae* was reared on *Antonina graminis* infesting Johnson grass and the life-history of this Encyrtid in the laboratory are described. The egg was deposited among the egg-mass in the host, with no attachment to the body wall, and hatched in 3–4 days at room temperature in late spring or early summer. The larva fed chiefly or entirely on the eggs of the scale, sometimes after the death of the latter, and pupated within the body of the host. The adult emerged through a circular hole in the posterior-dorsal end.

Equal numbers of males and females emerged in the laboratory, and pairing and oviposition occurred within an hour. Any living gravid scale was acceptable for oviposition, and eggs were laid repeatedly in the same individual. Unfertilised females also oviposited, giving rise to males only. The duration of the life-cycle varied from 15 days at room temperature in summer to 30 in early spring. Males emerged before females.